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THE MINNESOTA CONVENTION.

The second annual meeting of the Minnesota Electrical Association demonstrated that this organization is very much alive. One peculiarity of the Minnesota association not found in other State associations is the very active part taken by superintendents of municipal plants. In this State, as in Great Britain, many of the municipal-plant managers show an enterprise in working for new business of a profitable kind that would do credit to any private company.

Among the subjects taken up at convention, that of prime movers attracted the attention it deserves in a State where fuel is high and where water-powers are none too abundant. On account of this high cost of fuel in Minnesota, producer gas plants are receiving more earnest consideration than in many other parts of the country. There does not appear to have been much experience as yet with this type of plant. One such plant in the State, that at Fairmont, described in these columns in the issue of Dec. 19, 1908, seems to have been notably successful. To judge from the reports from this and other small plants throughout the Northwest, the greatest difficulty is in getting the plant started and learning to operate the engines and producers. Men who understand steam engines and boilers are plentiful, but there is as yet practically no place from which to draw men skilled in producer operation. For this reason men have to be trained after the plant is started, the result usually being that there is a period of three or four months when there is a most exasperating amount of trouble and interruption to service if dependence is placed entirely on the producer plant. After that first trying period is over and a crew is trained to run the outfit, the operation is as reliable as that of a steam plant with a similar reserve. The purchase of coal by heat-unit contract, which is becoming more prevalent, is also of special interest to Minnesota central stations because of the higher cost of fuel and the consequently greater money value of the heat units contained in coal than in cheap fuel localities.

In the matter of tungsten lamps, which is a live subject at every electric light convention these days, some very instructive figures taken from careful records on an actual installation of a large number of these lamps on ornamental iron posts in a downtown street was given by Mr. H. J. Gille from the records of the Minneapolis central station. These constitute some of the most trustworthy figures yet made public on the life of the tungsten lamp in commercial use. They indicate that tungsten lamps as now made, when burned on a circuit 2 volts lower than the rated voltage of the lamp, are giving an average life in excess of 800 hours. In fact, the average life of all the lamps on this installation since it was first put in service has been 780 hours, including those not yet

burned out, this average being considerably reduced by the shorter life of the lamps in the first installation as compared with the lamps recently used.

Electric Locomotive Types.

As noted elsewhere in this issue, the electrification of steam railroads was discussed at a recent meeting of the New York Railroad Club. The arguments presented as to the relative merits of the various systems of electric traction differed only in minor details from earlier discussions of the same subjects, each speaker emphasizing the advantages of a particular system. The most encouraging feature of the discussion resided in the noteworthy fact that the electrical engineer of each of the three roads using the direct-current, the single-phase and the three-phase systems was in each case the most enthusiastic advocate of the type of equipment adopted by his road. That is to say, experience has proved each system admirably suited for the service for which it was selected. Practical operation has shown that each type possesses in a marked degree all of the advantages claimed for it by its advocates, while the disadvantages urged against it by its opponents have largely failed to materialize.

Even Harmonics in Alternating-Current Circuits.

According to a well-known law of electrodynamics, the e.m.f. produced in a conductor when moved in a magnetic field is equal at each instant to the rate of cutting of the lines of force. When the speed is uniform the e.m.f. varies directly with the space distribution of the magnetism, and hence the e.m.f. in any single conductor on a revolving armature has an electrical-time value similar in all respects to the electrical-space value of the magnetism. Since there must be equal positive and negative values to the magnetism, each positive half-wave of the e.m.f.-time curve must be equal in area to a negative half-wave. This fact places at once a limit upon the possible shape of the e.m.f.-time wave produced by revolving machinery. When two or more conductors are joined in series to form a coil of an alternator, the e.m.f. produced in this coil has a time-value which is the algebraic sum of the time-values of the e.m.fs. in the component conductors. It will be seen, therefore, that in a single fractional-pitch coil on an armature revolving within a field core having, for example, strong trailing north magnetic pole tips and strong leading south magnetic pole tips, there would be generated an e.m.f. with a higher maximum in one direction than in the other. That is to say, the two half-waves of the e.m.f.-time curve would differ in shape, although their areas would be equal.

It may be stated in general that the coils on an armature are so interconnected and the field magnetism is so distributed that the negative half-wave of the e.m.f.-time curve is identical in shape and size to the positive half-wave, and hence it may safely be assumed that among the component sine waves of which it is formed the "even harmonics" of the fundamental are missing. In an article appearing in this issue Dr. C. P. Steinmetz shows that it is incorrect to assume that even harmonics are never present, because in certain transient phenomena in electric circuits the even harmonics of current may reach values comparable to the normal full-load current. A common example is cited in the starting current of a transformer, the transient term of which assumes a large value when the sum of the residual magnetic density and the normal operating density is much beyond the "knee" of the magnetization curve. It would seem that the facts discussed by Dr. Steinmetz would be of considerable importance in low-frequency transformers or in transformers of higher frequency in which use is made of the newer core material operated at high densities.

A Volt Scale for a Watts-Per-Candle Meter.

In the industrial photometry of carbon incandescent lamps it is commonly found convenient to operate the photometer in such a way as to indicate the voltage at which the tested lamp gives its rated candle-power. By this means lamps are separated into voltage classes so that plants and stations requiring one particular voltage can readily be supplied. This is a far more convenient procedure than rating the candle-power differently at one and the same voltage. But specifications for lamps frequently designate not only the voltage at which the lamps are to give their rated mean horizontal intensity, but also the specific consumption or watts per mean horizontal candle which they must offer. Mr. Herbert E. Ives describes on page 732 a method of applying a direct-reading scale to a specific-consumption photometer in such a manner that not only the actual specific consumption may be read off at the testing voltage, when the photometric balance has been secured, but also the corresponding voltage at which a certain assigned specific consumption should be expected. Thus, if, at the particular testing voltage of 115 volts, the lamp tested was read off at 16 cp, 3.41 watts per candle, the photometer scale would also be able to indicate that at 118.5 volts the lamp would consume 3.1 watts per candle, giving, of course, a certain correspondingly increased candle-power.

The fundamental importance of uniform initial specific consumption in incandescent lamps is connected with the fact that filaments of the same material and physical condition of surface, incandescing in bulbs of the same dimensions and degree of evacuation, consume the same initial electric power per mean spherical candle when worked at the same initial temperature. The rate of evaporation of the filament, or rate of diminution of light with time, depends upon the initial temperature of the filament. Again, the initial color of the light emitted depends upon the initial temperature of the filament. In lamps of the same type and form of filament the ratio of mean initial horizontal candle-power to mean initial spherical candle-power is constant, so that the initial temperature of lamps of the same type and form of filament is defined by the initial watts per mean horizontal candle-power. The only rational basis for the comparison of lamps with filaments of the same material is, therefore, a common initial specific consumption.

The additional scale on the photometer by means of which the voltage of standard specific consumption is indicated has been worked out from a certain experimentally determined relation between rise in lamp-terminal volts and rise in specific consumption. Thus, treated carbon lamps of a certain type are found to diminish 3.5 per cent in specific consumption when raised 1 per cent in voltage, if the voltage change is small. A special form

of slide rule could readily be designed for such computations; but by preparing a suitable scale once for all, the photometer can be made to point out the assigned voltage of constant specific consumption for a fixed initial horizontal candle-power and a fixed testing voltage. It is doubtful whether the ordinary photometer would be improved by attempting to add such a scale to its ordinary indicator. There can be no doubt, however, that in a lamp factory where many lamps of the same candle-power and of the same type of filament have to be photometered there might be an advantage in the use of this device.

THE SLEET QUESTION.

We are publishing this week two interesting considerations, one regarding data on, the other touching methods of dealing with, the design of lines against sleet stresses. The winter now closing has been marked by several severe sleet storms, one of which proved conspicuously disastrous to the Washington inauguration program. A sleet storm involves a double danger to all overhead lines. In the first place, the mere weight of the icy coating may first break the wires, and then, by throwing heavy unbalanced strain on the poles, bring them down also. Second, by increasing the surface of the suspended wires, it may bring wind pressure into action to an extent that will also act so as to bring down both wires and poles. As a matter of experience, the circuits that suffer most severely are telegraph and telephone lines, the ordinary electric lighting circuits holding up well as a rule, and the transmission circuits being very rarely injured. As a rule, telegraph and telephone lines are circuits of many wires, rather small ones at that, and are upon poles of no great strength not always well maintained. Inasmuch as experience seems to show that small wires do actually accumulate as thick coatings of sleet as large ones, one would not go far wrong in assuming that the sleet strains on the pole line increase directly with the number of wires, which accounts for the facts just noted.

Mr. Collbaum's note contains much interesting information on this point. He found that in the Wisconsin storm of Jan. 28 practically all the wires in the affected region were coated with snow and sleet up to diameters ranging from 2½ in. up to as much as 4 in. During this state of affairs the temperature ranged down to —4 deg. Fahr., and the wind velocities recorded up to 40 miles per hour. This combination of cold and high wind is a very unusual one in most parts of the country, and such a record is important. It is generally assumed that sleet does not form coherently save around the freezing point, so that it is pertinent to inquire as to the exact conditions in this instance. Fortunately, Mr. Collbaum gives some valuable data on the actual weight of the coating, which proved to be about ½ lb. per running foot on wires broken down during this storm. If the coating were of the general diameter just mentioned, the evidence is conclusive that the formation was not sleet properly so called, but an agglomeration of sleet and snow of far less density than compact ice. Coatings of ice of such thickness would have weighed, say, from 2 lb. to 5 lb. per running foot, instead of ½ lb. It would be very interesting to learn what similar figures for diameter and weight of sleet-coated wires have been found elsewhere, and we trust that some of our correspondents will furnish similar data from which a clear idea of sleet density can be formed. It seems probable that a coating approximately the density of clear ice can be formed only at temperatures very near the freezing point. A coating such as Mr. Collbaum describes is dangerous, chiefly on account of wind pressure in the case of anything but small and relatively weak wires. In ordinary designs of transmission lines the coating is generally assumed at the density of clear ice, and a moderate wind pressure, always as great as 40 miles per hour, should be taken into account. It must be remembered, however, that the reported wind velocity is always given directly from the anemometer readings, which are materially higher than the true velocities, save in very moderate winds. For instance, a 40-mile wind (indicated) has a real velocity of 33.3 miles, and a 60-mile wind a real velocity of only 48 miles. The true velocities are those to be used in the preliminary computations of the pressures due to wind.

The formulas given by Mr. Glaubitz bear directly on the design of lines to meet sleet and wind strains. A glance at them shows the importance of giving close attention to the matter of deflections. Tight stringing of wires increases danger from sleet and wind without any material compensating advantages. In laying out a line it is obviously important to take into close account the climatic conditions to be met. While wind velocity increases with height above the ground, it must not be forgotten that the wind observations are taken at a distance above the ground greater than the height even of steel line towers, and, as published, are not reduced to ground level, which, in fact, would be a rather difficult thing to do. Hence probably one is likely to get a very much exaggerated idea of the actual wind pressure to be met by a line. There is very little danger of getting enough wind strain even on a sleet-covered wire large enough to actually endanger the poles.

The real risk is in breaking the wires from excess of initial tension, and by the sudden release of strain pulling down the poles by the weight of the adjacent spans. A pole line, whether of wood or steel, should be planned to allow sufficient flexing in such case to drop the catenary to the safest point without upsetting the poles. The common assumption of a rigid pole is incorrect in theory, and bad in practice. With the wires ordinarily used in high-tension transmission lines, there is very little danger to the poles from combined sleet and wind, if the wires are properly strung. In fact, transmission line design is far more likely to err in the direction of entirely needless strength than toward weakness. The alleged immunity of very high-tension lines from sleet formations is open to a good deal of doubt; in fact, there is little to show that one can rely upon it. But, on the other hand, there are practically no records of such dense and thick sleet coatings on transmission wires as have been observed on smaller wires in the quieter air near the ground, and the wind velocities allowed for are most commonly abnormally high. Ample factors of safety should be allowed without going into extreme precautions against conditions of which there is no probability. A liberal sag on long spans is the best defense against abnormal stresses.

The New Tariff Bill.

The new tariff bill introduced into Congress, March 17, makes notable changes in duties on many classes of electrical manufactures and material. Where ad valorem rates are substituted for specific rates, these changes are particularly large in certain lines, and in many cases undoubtedly much greater than were anticipated by the framers of the bill. Aside from some schedules of great popular interest, the tariff rates in the bill as introduced will without question be subject to very considerable revision, both in the House and in the Senate.

The most striking change in the tariff, so far as affects the electrical industry, is the reduction of duty on electrical apparatus and machinery from 45 per cent to 30 per cent. As there have been practically no importations under these schedules, the effect of the lower duty, if maintained, can scarcely be even conjectured. The change in the duty on arc light carbons is perhaps of greatest interest, in view of the dependence of the electric lighting industry on certain grades of foreign-made carbons. Under the Dingley bill the duty on carbon electrodes was advanced from 30 per cent ad valorem to 90 cents per 100 carbons. As the latter bill contained no specifications as to the length of the carbons, it has been the custom to import all except the higher grades in double lengths, which thus reduced the duty to 45 cents per 100; on the other hand, owing to the greater breakage of the longer carbons and the labor of cutting, the final charge on carbons imported in double lengths often fell little short of 60 cents per 100. Under the new tariff the duty has been changed to 35 per cent ad valorem. In the case of cheaper carbons this is, of course, a very considerable reduction, but for expensive carbons, such as are used in flaming arc lamps, the duty is considerably increased. Carbons under $26 per 1000 would pay less duty under the new rate, while on carbons above that value, the duty will be higher, and notably so in the case of flaming arc carbons and carbons for searchlights, in the latter case the increase being as much as 1000 per cent.

There is no change in the duty on either incandescent or arc lamps, both of which at present are classified under manufactures of metal, the duty on which remains 45 per cent.

The duty on mica has been changed from 6 cents per pound and 20 per cent ad valorem, to 30 per cent ad valorem on plain mica, and to 35 per cent ad valorem on built-up mica. While this change reduces the duty on mica of low grade or the smallest sizes, costing about 54 cents per pound or less, it increases the duty on the better grades and larger sizes, costing more than 54 cents per pound, large quantities of which are used in the electrical industries.

The duty on aluminum in crude form has been reduced from 8 cents to 7 cents per pound, and in the form of plates, sheets, bars and rods, from 13 cents to 11 cents per pound. As this is equivalent to a protection of not far from 50 per cent on the basis of present aluminum prices abroad, the decrease in duty will probably not result in any importations, but may affect domestic prices to the extent of the reduction.

Of material used in the manufacture of storage batteries, the duty on lead has been changed from 2⅛ cents to 1½ cents per pound; on red lead from 2⅞ cents to 2⅜ cents per pound, and on litharge from 2¾ cents to 2¼ cents. The price of lead has been arbitrarily fixed in this country, and the new duties, if maintained, will have the effect of lowering the upper limit of price.

The duty on zinc in pigs is reduced from 1½ cents to 1 cent per pound, and in sheets from 2 cents to 1¼ cents.

A section of the tariff bill provides for maximum duties to meet the case of customs discrimination against the United States by other countries. The effect of this section of the act can in most instances only be determined by a close examination of the tariff schedules of the world, and its provisions probably would not apply to electrical exports except in the case of a tariff war with Germany.

Proposed Federal Corporation Tax.

It is reported that President Taft has had a bill drafted for introduction before Congress taxing the dividends declared by corporations at the rate of 2 per cent. Treasury experts have calculated that such a measure would produce a revenue of $15,000,000 per year, or $5,000,000 less than the inheritance tax provided in the Payne tariff bill. The corporation tax would supersede the latter measure owing to expected opposition to it in the Senate on the ground that it would conflict with State taxation of inheritances. As none of the details of the proposed corporation tax has as yet been developed, it is not known if it applies to corporations not engaged in inter-State commerce, such as electric lighting, railway and telephone companies.

Electric Railways in Canada.

Electric railway building in Canada during the past year experienced a large falling off. For the year ending Dec. 31, 1908, 32.94 miles of electric railway track were laid in Canada, as against 72.27 during 1907. With the exception of a line from Brantford to Ancaster, Ont., which was built by the Brantford & Hamilton Electric Railway, and the Mount McKay & Kakabeka Falls Electric Railway, all the work was extensions to existing lines. At the present time the British Columbia Electric Railway has under construction considerably more mileage than was covered by all Canadian companies in the two years mentioned. The following is a list of the construction accomplished:

	Miles.
Brantford & Hamilton (Brantford-Ancaster line)	16
Montreal Street Railway, Montreal, Que.	1.31
Winnipeg Electric Railway, Winnipeg, Man.	6.00
Toronto Electric, Toronto, Ont.	.23
Montreal Park & Island Railway, Montreal, Que.	1.97
Mount McKay & Kakabeka Falls, Fort William, Ont.	3.00
Ottawa Electric, Ottawa, Ont.	1.80
Sarnia Street Railway, Sarnia, Ont.	1.25
Toronto & York Radial, Toronto, Ont.	1.38
Total	32.94

Practically all the companies mentioned above, as well as a number of others, plan many extensions for 1909.

Large Mexican Electrical Development.

The Mexican Northern Power Company, incorporated by the Dominion of Canada, has secured the rights to a perpetual concession granted by the Government of Mexico for the development of the water-power on the Conchos River, in the State of Chihuahua, Northern Mexico, and its utilization, to generate electrical energy for the supply of cities and towns of that State and its mining districts.

The water-power, which is at Parral and has been examined by Mr. Wm. F. Tye, civil engineer, of Montreal, will develop 25,000 hp. It is proposed to build the necessary dams and transmission lines for 25,000 hp, but to install initially machinery, hydraulic and electrical, for 15,000 hp only. The cost of construction for this is estimated at about $4,500,000 gold, and to increase to 25,000 hp will involve an additional outlay of $500,000. The selling price for the electrical energy is figured at $75 per annual horse-power on the peak load.

The district this company will serve is one of the largest and oldest of the mining districts of Mexico, and lies within 50 miles of the plant. The capital of the State is a city of 70,000 inhabitants. The capital of the Mexican Northern Power Company is to be $10,000,000 stock and $7,500,000 bonds. The board of directors are Messrs. E. B. Greenshields, Edwin Hanson, B. F. Pearson, S. J. Moore and others. The officers are: President, Mr. G. F. Greenwood, Montreal; vice-president, Mr. E. B. Greenshields; secretary, Mr. Frank Thompson. A number of the stockholders were at one time stockholders in the Mexican Light & Power Company, also a Canadian organization.

Lectures on Electric Vehicles.

A lecture will be given on Monday, March 29, 1909, at 8 p. m., in the Electricity Building, Case School of Applied Science, Cleveland, Ohio, and on Wednesday, March 31, at 8 p. m., in the rooms of the Western Society of Engineers, Monadnock Building, Chicago, Ill., by Mr. Bruce Ford, of the Electric Storage Battery Company, Philadelphia. The subject of the lecture will be the "Exide Battery in Vehicle and Sparking Service," and will be illustrated with a series of lantern slides. A general discussion of the subject will follow in which all present are invited to take part. At the Chicago meeting an address will also be given by Mr. E. W. Lloyd, contract agent of the Commonwealth Edison Company, on the relations of central stations to the automobile business.

Association of Central Station and Electric Vehicle Companies.

At a dinner given in Boston, March 11, a new organization was formed for the purpose of uniting manufacturers of electric vehicles and the managers of central lighting and power stations. The purpose of this new organization is to promote the use of electric vehicles for business and pleasure, and to stimulate both the vehicle manufacturer and the central-station manager to renewed effort to increase the popularity of these vehicles. Those interested in the formation of the association considered the body would be equally advantageous to the manufacturer and the central-station man in that the revenue derived from the sale of energy will aid in straightening out the load line on the power station and the facilities extended by the central station for the recharging of batteries will popularize the use of these vehicles.

The meeting was well attended and addresses were made by Mr. W. H. Atkins, Boston, representing the Boston Edison Company; Mr. William P. Kennedy, chief engineer of the Studebaker Company, and Mr. Frank J. Stone, Boston, representing the Electric Storage Battery Company, and others.

The officers of the association are: President, Mr. Frank J. Stone; secretary, Mr. H. F. Sands; treasurer, Mr. L. R. Wallis; executive committee, Messrs. Day Baker, Col. E. W. M. Bailey, S. G. Thompson, A. C. Gray, A. F. Neale, J. H. Neal, E. C. Manson, C. B. Davis and N. T. Wilcox.

Electric Vehicles.

As noted on page 541 of our issue for March 4, 1909, the Pacific Coast Electric Automobile Association held its convention in San Francisco on Feb. 19 and 20, at which time papers dealing with the mechanical and electrical features of electric vehicles were read and discussed. The discussion of a paper by Mr. Geo. R. Murphy brought out many interesting points relating to the practical operation of vehicle batteries. It was stated that since the watt-hour efficiency of the lead battery is 75 per cent and that of the nickel-iron battery only 50 per cent, that latter requires 50 per cent more energy than does the former for the same effective output. Mr. McDonald called attention to the fact that, on account of the gradual improvements in lead batteries, tires and mechanical parts, the mileage per charge of electric vehicles is twice as great to-day as it was 11 years ago. Mr. Briggs said that, although some trouble may be experienced in removing the opinions based on earlier performances, the electric vehicle of to-day, with its improved batteries and motors, is an excellent machine. Mr. Daggett remarked that since the electric automobile is employed as a town vehicle and not as a touring car a travel of 70 miles per charge, as now obtained on level road, is entirely satisfactory. Mr. Stevenson stated that lead batteries should be washed at the end of each 3000 miles of travel of the vehicle. A battery lasts about 9000 miles, so that it requires two washings. The separators are renewed at each washing. Mr. Murphy said that washing cannot be accomplished in less than one day. If the battery is properly handled only a small percentage of the separators will need renewal. The positive plates can withstand about 300 charges while the negatives can withstand from 450 to 500 charges.

Mr. Geo. C. Holberton, in discussing a paper by Mr. F. T. Kitt, entitled "Relation of Central Stations to the Automobile Business," expressed the opinion that although special prices should be made for charging automobile batteries, a supply company should not adopt the suggestion of having a clause in the contract for using energy during non-peak hours. A better plan is to use two meters, charging a certain rate for certain hours per day. In Oakland the rate for charging automobiles is 5 cents per kw-hour with a discount based on the amount of energy used. Mr. Daggett remarked that central stations should encourage electric vehicles by purchasing them for their own use, and should advertise them as they do heating devices and motors. Mr. A. C. Downing said that the Union Electric Light & Power Company, of St. Louis, by taking the agency of electric vehicles, and advertising them by means of electric signs, has developed a large electric automobile business; it cares for 75 machines per night. In commenting on a statement by Mr. Harvey that observation shows that the average mileage for all types of automobiles, including touring cars and runabouts, is 30 per day, Mr. Daggett said that this fact shows that most gasoline machines used in cities can be displaced with electric vehicles.

In discussing a paper relating to electric vehicle motors by Mr. J. G. De Remer, Mr. A. C. Downing said that the shunt and compound-wound motors are being abandoned in favor of series-wound machines. Mr. Daggett expressed the opinion that in a hilly city the series-wound motor is best.

In discussing his own paper on commercial electric vehicles, Mr. A. C. Downing said that the modern pleasure vehicle should have a life of from 10 years to 15 years, tires and batteries not being considered. The life of a commercial vehicle should be 10 years. The life of a gasoline car is much less, while its cost of maintenance is much higher. Mr. Perrine expressed the opinion that the cost of operation of an electric delivery wagon is about one-half that of a gasoline wagon for the same service. An electric delivery wagon will perform the work of two horse-drawn vehicles. Mr. Downing explained that the cells of the battery of an electric truck are divided into two groups that are connected in parallel for low speed and in series for high speed. Moreover, the field coils are arranged for series-parallel connection, thus giving four efficient speed points. Mr. Daggett stated that there are now 900 commercial electric trucks in operation in New York, 50 in Chicago, 71 in Boston, 15 in Cleveland, 70 in St. Louis, 25 in Los Angeles, 5 in Seattle and 1 in San Francisco.

The discussion of electric pleasure vehicles was opened by Mr. Vance, who remarked that the unwarranted promise by the daily newspapers of a 200-mile battery has proved a serious obstacle to the introduction of electric vehicles. The high cost of an electric pleasure vehicle has also been an obstacle. Mr. Downing stated that the introduction of electric automobiles requires merely the giving of the proper information to the public. Mr. Pfaffmann said that newspaper publicity should be encouraged, while a liberal use should be made of electric-sign advertising. Mr. Daggett stated that a vehicle battery forms an excellent load for the central station from midnight until 6:00 o'clock in the morning.

New Type of Tantalum-Lamp Filament.

A patent issued March 16 to Werner von Bolton, Charlottenburg, Germany, describes a new type of incandescent-lamp filament, consisting of a homogeneous mixture of metallic tantalum intimately commingled with a carbide of tantalum or of a metal of the vanadium group. The most advantageous form of the invention is stated to be a mixture of tantalum and tantalum carbide, and is secured by heating tantalum powder held in a plastic mass by a binder which is carbonized by heat, thus giving rise to the carbide of the metal.

Minnesota Electrical Association Convention.

The Minnesota Electrical Association held its second convention at Hotel Nicollet, Minneapolis, March 18 and 19. As the president, Mr. W. R. Putnam, formerly of Red Wing, Minn., has moved to Menominee, Mich., the sessions were presided over by Mr. R. E. Brown, of Mankato, of the executive committee. Mr. Ludwig Kemper, of Albert Lea, presented his report as secretary and treasurer, which showed receipts of $725.10 and cash on hand $215.59. The membership committee, of which Mr. B. W. Cowperthwait, of Faribault, is chairman, reported 17 applications for active membership and seven for associate membership during the year. The secretary and treasurer announced that seven more applications for membership had been received just before the opening of the first session. Mr. Ludwig Kemper submitted an amendment to the by-laws, providing for a standing publicity committee. Consideration of this amendment was referred to a committee of three, which reported at the last session.

Mr. Ludwig Kemper, of Albert Lea, presented a paper entitled "Buying Coal on a B.T.U. Basis." After some discussion on the coal question, Mr. T. L. Daniel, of the Minneapolis Steel & Machinery Company, read a paper on "Prime Movers for Small Central Stations," which reviewed the advantages of engines of high- and low-speed types, steam turbines and producer-gas plants for small companies. After considerable discussion on this paper the first session was adjourned.

The Thursday afternoon session was opened by the reading of a paper by Prof. George D. Shepardson, of the University of Minnesota, on "Meters." This paper gave a review of the principal types of meters and presented some curves taken from tests made by Professor Shepardson showing some of the things which alter the registration of meters, such as vibration, cleaning commutators and changing of jewels. One of the notable points brought out was the fact that vibration causes a meter to run much too fast on light load. After this paper the convention adjourned to inspect the electrical and mechanical engineering departments of the University of Minnesota. The power plant of the electrical engineering department is well designed to give students experience with a large variety of electrical and steam-generating apparatus. One of the most interesting features to many who are considering more economical apparatus for small plants is the Muenzel suction gas producer and engine, which were in operation at the time of the convention's visit. Thursday evening the convention was entertained by the jobbers and manufacturers of Minneapolis and St. Paul by a dinner at the Nicollet Hotel, followed by a theater party.

The Friday morning session was given over to a discussion of developments of day load, three papers along this line being presented. One was by Mr. Adolph Wagner, of New Ulm, on "Methods of Building Up a Day Load in a Small Central Station." Another was by Mr. E. L. Callahan, of the General Electric Company, on "Heating Appliances as an Aid in Developing Day Load." Mr. George J. Cadwell, of Minneapolis, read a paper on "Small Motors and Their Possibilities in Developing a Day Load," calling attention to the small motor applications possible in small towns with special emphasis on the advantage of single-phase motors and single-phase distribution. This question of working up a day load brought out a long discussion, and a number of members, both from private and municipal plants, gave some experiences which should be very encouraging to those who are contemplating the starting of day service.

Friday afternoon was taken up mainly with subjects related to the application of the tungsten lamp. Mr. J. R. Cravath read a paper on "The Use of Tungsten Lamps from the Illuminating Engineering Standpoint." Mr. H. J. Gille, of the Minneapolis General Electric Company, in a paper on "The Use of Tungsten Lamps for Decorative Street Lighting," gave some valuable figures on the cost of installation and life of the tungsten lamps used for lighting Nicollet Avenue, this being unquestionably one of the finest pieces of special permanent street lighting in the country.

The discussion on tungsten lamps was followed by the election of officers, which resulted as follows: President, Mr. H. J. Gille, contract agent of the Minneapolis General Electric Company; first vice-president, Mr. Thomas Pitts, manager, Hutchinson Lighting & Manufacturing Company; second vice-president, Mr. George Marvin, chief engineer, Public Service Company, St. Cloud; secretary and treasurer, Mr. B. W. Cowperthwait, secretary, treasurer and manager, Faribault Gas & Electric Company, Faribault, Minn. Executive committee: Messrs. H. A. Hildebrand, manager, Municipal Electric Light & Waterworks, St. Peter; E. F. Strong, manager municipal electric light plant, Chaska; E. W. Erick, manager, South St. Paul Electric Light, Heat & Power Company. The committee on resolutions presented resolutions expressing the appreciation of the work done in advance of the convention by Mr. W. R. Putnam, as president, and Mr. Ludwig Kemper, as secretary and treasurer, and extending the thanks of the association to the entertainment committee for the entertainment provided, and the sympathy of the convention for Mr. T. R. Gordon, who was called away during the convention by serious illness in his family.

Mr. H. J. Gille, chairman of the committee appointed to consider the advisability of a permanent committee on publicity, reported favorably to the establishment of such a committee. He stated that many advertising schemes were being presented to the smaller companies throughout the State by advertising companies, and that this committee could investigate these schemes to determine whether they were legitimate or not. A motion was carried that a publicity committee of five be appointed by the coming president.

Mr. E. W. Erick asked whether members had information as to the cost of operating electric trucks, as compared with maintaining horses for the same purpose. Mr. Gille, of Minneapolis, said that the literature published by the Studebaker Automobile Company contained a large amount of information on this subject, some of which he knew personally had been obtained from experience at Minneapolis and was correct.

Abstracts of the papers and discussions will appear elsewhere in this and in following issues.

Mr. H. J. Gille, president-elect of the Minnesota Electrical Association, is contract agent of the Minneapolis General Electric Company. He has been prominent in the electric lighting field in Minneapolis and St. Paul for a number of years and has taken an active and useful part in the National Electric Light Association and in the Northwestern Electrical Association. Mr. Gille was born on a farm in Minnesota in 1870. There he remained until 15 years old, obtaining his early education in the country district school. He worked his way through Curtis College, in Minnesota, graduating in 1889. From 1889 to 1891 he was with the Acme Electric Company at St. Paul. In 1891 he went with the Northwest Thomson-Houston Company, at St. Paul. Part of his time was spent at the Lynn (Mass.) factory. He remained with this company in various capacities until 1894, when he was transferred to Chicago as assistant to Mr. F. N. Boyer, manager of the supply department.

Mr. Gille remained there one year, and in 1895 became Western electrical engineer for the Washburn & Moen Manufacturing Company. From 1898 to 1908 he was general superintendent of the St. Paul Gas Light Company. During that time he had charge of all the important changes and developments in the electrical department of that company, including the changing from overhead to underground distribution in the downtown district of St. Paul and the consolidation of several power stations into one. During that time water-power was transmitted into the city and a large substation established. Since 1907 he has held his present position as contract agent of the Minneapolis General Electric Company. During the last few years of his stay in St. Paul he gave particular attention to the commercial developments of the company there, and worked up the special lighting of many

of the downtown streets by means of incandescent lamps on ornamental posts. Since going to Minneapolis he has succeeded in doing the same thing in an improved manner for Nicollet Avenue, and contracts are under way for several other prominent streets of Minneapolis. Besides his work in the executive and operating field, Mr. Gille has made several notable inventions. One of these is a system of distribution employing a number of busbars at the central station, operated at various voltages, so as to give equal pressure at centers of distribution. He is also the inventor of the solar-colored lamp car for decorative lighting and of several forms of electric signs.

Meeting of Ohio Independent Telephone Association.

The annual convention of the Ohio Independent Telephone Association, held at the Hartman Hotel, Columbus, on Thursday and Friday of last week, had an attendance of about 200, and was one of the most enthusiastic conventions held by it.

President Frank L. Beam presided, and on Thursday morning addresses of welcome were delivered by Mayor C. A. Bond and President Perry, of the Columbus Board of Trade. H. S. Grimes, of Portsmouth, Ohio, responded in a brief and appropriate address. This was followed by the report of President Beam, who congratulated the association upon the rapid growth of the business, which he illustrated by statistics gathered by himself and other officers for the purpose of comparison. He vigorously objected to any exchange connections with competing companies on the ground that it would be both ruinous to competition and a disadvantage to the independent movement. In fact, it would render that movement of little effect and cause the business to effectually revert to the old standard. This feeling is shared by all the members of the organization, it is believed.

A discussion regarding increase in rates brought out the statement from several members that first-class service demanded an increase in many places after the number of subscribers had passed a certain point. The trouble is that many of the exchanges started at too low a rate, with the idea that the business would not reach its present enormous proportions. Inexperience in the earlier days of the independent business is also responsible for some of the rates then fixed.

Mr. E. H. Moulton, of Minneapolis, president of the International Independent Telephone Association, in an address suggested the organization of a large financial institution to handle independent telephone securities and look after the interests of the companies. He thought this a better plan than depending upon banks and trust companies for taking care of the finances of the various independent companies. This suggestion was referred to a committee for consideration. Mr. Moulton congratulated the Ohio men on the progress they have made and upon the interest they have taken in the extension of the movement to other States. Mr. E. G. Tillotson, recently chosen president of the Cuyahoga Telephone Company and chairman of the board of the United States Telephone Company, followed with a short talk along lines of interest to those especially who have the problem of financing new companies or improvements before them.

Several plans were discussed for securing an entrance into Cincinnati, and within the next year, no doubt, an attempt will be made to invade that heretofore impregnable Bell stronghold. The next convention would be held in that city in order to arouse interest there, were it not for the fact that the constitution and by-laws provide that all such meetings shall be held in Columbus. It may be that a special meeting will be held there later in the year, when the southern Ohio counties will combine with those of Kentucky, West Virginia and Indiana in showing the business men of the Queen City the advantages to be derived from the independent lines.

All the officers of the association were re-elected as follows: President and manager, Mr. Frank L. Beam, Mount Vernon; secretary, Mr. O. O. Welsheimer, Columbus; treasurer, Mr. Ralph Reamer, Columbus. Messrs Frank A. Davis, president of the Columbus Citizens' Telephone Company, and D. J. Cable, of Lima, were chosen as members of the board of directors of the United States Telephone Company, whose lines connect with almost all the independent exchanges of the State. For this reason the officers of the long-distance company felt that the local companies should have representation on the board, and it was at their request that such action was taken. Thirty-three delegates and the same number of alternates were chosen for the annual convention of the International Telephone Association, which will be held several months hence.

In the evening a banquet was held in the large dining-room of the Hartman, with Mr. Frank A. Davis, president of the Columbus Citizens' Telephone Company, as toastmaster. The responses were as follows: "Lightning Arresters," Mr. Thomas E. Powell, Columbus; "Getting Down to Business," Mr. Charles A. Otis, Cleveland; "Thought for the Discouraged Farmer," Mr. Butler Sheldon, Columbus; "Looking Into the Future," Mr. John A. Howard, Wheeling, W. Va.; "Telephone Organization by Counties and Districts," Mr. D. J. Cable, Lima.

Reports of officials show that on Oct. 1, 1908, the total number of independent telephones in use in the State was 325,541 in comparison with 307,674 on the same date the previous year. At that time 893 exchanges were in operation as compared with 879. Toll stations numbered 1690, while a year before there were 1895. Stockholders had increased from 25,458 to 30,976. It is claimed that the Bell companies had but 171,161 telephones, 299 exchanges and 848 toll stations on Oct. 1 last. This includes Cincinnati and Hamilton County, which the independents have not been able to develop.

The second day of the convention was devoted to a discussion of subjects of particular interest to managers and held behind closed doors. In fact, it was peculiarly a managers' session and information as to the proceedings was not given out because of the nature of the meeting.

Fuel Conference at University of Illinois.

Much of the time of the Illinois Fuel Conference, held at the University of Illinois, Urbana, Ill., on March 11 to 13, was devoted to mine-accident and mine-rescue work, and to an inspection of the United States Geological Survey's laboratory at Urbana. Mr. R. Y. Williams, mining engineer of the United States Geological Survey, is in charge of the laboratory. Many mine operators and mine inspectors viewed the apparatus used in effecting rescues in coal-mine disasters. About 125 persons attended the conference. The United States Government was represented by Mr. George Otis Smith and others of the Geological Survey. The Geological Survey of the State of Illinois was represented by Mr. H. T. Bain and Dr. U. S. Grant.

The conference also held sessions devoted to the subjects of "Smoke Suppression" and "Economy in the Use of Fuel for Industrial and Domestic Use." Among those taking part in the smoke-suppression discussion was Dr. W. A. Evans, commissioner of health, city of Chicago, who presented a paper giving medical statistics showing the relative and growing importance of the so-called air-pollution diseases. Mr. Paul P. Bird, chief smoke inspector of Chicago, called attention to the needs of greater recognition by the State of the manufacturing industries. Mr. A. Bement, consulting engineer, Chicago, spoke on the need for equipment specially designed for the successful and smokeless combustion of Illinois fuels. Mr. D. T. Randall called attention to the work of the Geological Survey which is aiming to afford the small manufacturer and coal-user some enlightenment on the subject of burning bituminous coal without smoke. Mr. R. H. Kuss, chief assistant smoke inspector of Chicago, brought out the fact that a strict enforcement of the city ordinance in Chicago has not had the effect of driving Illinois fuels out of the market, but has resulted in the use of better apparatus in many cases where higher-priced Eastern fuels would have been used.

In the meeting devoted to economy in the use of fuel Mr. Bement gave some time to an exposition relating to inert matter in coal as having an influence on its economical use in in-

dustrial plants. Mr. D. T. Randall, engineer in charge of tests at the United States Geological Survey Experiment Station, Pittsburgh, presented a paper on "The Selection of Coal for Boiler Furnaces." Mr. R. H. Kuss pointed out that there is great need for accurate data connected with return tubular boilers applied with different forms or parts of furnaces. He also called attention to the fact that one of the prevalent causes for lack of economy is the use of too much grate surface and its co-related defect, too little draft. He made a plea for the plant owner, who received very little assistance heretofore from the different bodies studying steam plant economy.

Mr. W. H. Taylor, fuel engineer, Chicago, related some interesting personal experiences along domestic heating. Mr. J. M. Snodgrass, in charge of fuel investigations, Engineering Experiment Station, University of Illinois, devoted considerable time to the recent tests conducted under his direction, in which several house-heating plants were operated with various kinds of fuels. Mr. N. W. Lord, director of the School of Mines, Ohio State University, presented a paper on the subject of proper sampling and analyzing of bituminous coals.

One of the closing acts of the Fuel Conference was the appointment of a committee, under the chairmanship of Mr. Carl Scholz, president of the Illinois Coal Operators' Association, the duty of which is to place before the Illinois Legislature all of the important facts indicating that it is necessary to establish at the University of Illinois a department of mining engineering on a plane equivalent to the other engineering departments of that university. Steps are being taken to bring about the desired result before the present Legislature adjourns.

New York Public Service Commission News.

Propositions to build subways in the city of New York continue to come to the Public Service Commission of the First District. As yet none has been received upon which work can be commenced except that for the extension of the Hudson & Manhattan Railroad north under Sixth Avenue. The last proposal received was from the Bradley-Gaffney-Steers Company, a contracting and building corporation. In a letter sent to the commission last week this company proposed to build the Lexington Avenue subway from the Bronx down to a connection with the bridge loop now in process of construction between the Williamsburg and Brooklyn bridges. It is proposed by the company to construct this line entirely upon private capital, the company retaining the right to operate the system until such time that the city desires to purchase it. It is provided that the city may purchase the entire property at any time by paying to the company all of the actual expenses incurred for building and equipment, plus 15 per cent as an engineering profit. The city shall also pay 5 per cent per year, as interest on the money invested, during the period that the property remains in the hands of the builders. One interesting feature of the proposition is the practical partnership that is offered to the city in the operation of the road. It is proposed that the management of the property shall remain in the hands of a board of seven members, four of whom shall be named by the builders, and the remaining three to be the Mayor and Comptroller of the city and the chairman of the Public Service Commission. The proceeds from the operation of the line, after the payment of expenses, maintenance and the interest upon the cost, shall be devoted, one-half to the payment of the cost and the remainder turned over to the builders as a profit. The financial backing of this company is said to be ample, although its source is not explained. Rumor has it that either the Pennsylvania Railroad or the New York, New Haven & Hartford is behind the proposition. Mr. William Bradley, who is heavily interested in the company, was a contractor for much of the present subway, and is building a great part of the bridge loop. Mr. James S. Gaffney was formerly a member of the contracting firm of Murphy & Gaffney, who have done a large part of the tunnel work for the big Pennsylvania Railroad terminal. It is claimed that the company making the proposition has all of the necessary machinery on hand to enable it to begin work at once if its proposal were accepted and the necessary changes in the law were made. The estimated cost is about $50,000,000.

At a hearing before the Public Service Commission of the First District, upon the approval of a franchise granted by the Board of Estimate, permitting the Third Avenue Railroad Company to build a loop around the top of Fort George hill, it was disclosed that Receiver F. W. Whitridge had already begun the construction of the line, and, in fact, had almost completed his track laying. The commissioners were indignant and threatened to begin action immediately against the railroad company for the collection of penalties for the violation of the law.

Two bills were introduced in the Legislature at Albany last week increasing the powers of the Public Service Commissions in New York. One of these measures extends the jurisdiction of the commissions to telephone and telegraph companies and the other provides a number of general amendments to the law which mostly have to do with the regulation of rates and transfers upon traction lines. It provides that the traction companies shall agree as to transfers and a division of rates and that when they disagree, the commission shall have the power to settle the matter and compel the companies to accept its rulings. It gives the commissions the right to order where and when through cars shall be operated, over tracks that have common points, and to determine how many transfers may be demanded upon the payment of one fare, and the directions and time within which they may be used. Where repairs and improvements are to be made for the benefit of more than one road the commission is given the right to determine upon what basis the expense shall be divided. In addition, the amendments provide that the vessels operated by any railroad as a portion of its water route, shall be under the control of the commission, and that conduits for electrical conductors of public-service corporations shall also be under the control of the commissions. Other amendments extend and amplify the commissions' powers over the rates and contracts of all public-service corporations.

The corporation counsel of the city of Mount Vernon has protested to the Public Service Commission of the Second District of New York against its granting the application of the New York, New Haven & Hartford Railroad Company for authority to purchase the stock of the New York & Portchester and the New York, Westchester & Boston railroad companies until it has been determined which line the New Haven company proposes to build. It is charged, in the protest, that the Portchester franchise contains few restrictions, while that of the Westchester company provides that ownership could not be transferred without the consent of the city, and also provided for specified rates of fare, location of stations, construction of tracks, etc.

American Railway Engineering and Maintenance of Way Association.

The tenth annual convention of the American Railway Engineering and Maintenance of Way Association was held in the Auditorium Hotel, Chicago, March 16 to 18. A great deal of work relating to railroad engineering was accomplished, and there was a record attendance of members, 335. In addition there were several hundred guests and visitors. Mr. William McNab, of the Grand Trunk Railway, Montreal, was re-elected president and Mr. E. H. Fritch, 962 Monadnock Building, Chicago, was re-elected secretary. The association has a committee on electricity, but it has done no work, although a report is looked for at the next annual convention.

A long report was presented from the committee on signaling and interlocking, of which Mr. A. H. Rudd, of the Pennsylvania Railroad, Philadelphia, is chairman. Many of the committee's recommendations were referred back to it for further consideration, but the specifications for rubber-covered wire were adopted.

Meeting of Pittsburgh A. I. E. E. Section.

The regular monthly meeting of the Pittsburgh section of the A. I. E. E. was held in the Carnegie Institute, March 9, Mr. W. E. Reed, chairman, presiding. The usual preliminary dinner was held at the University Club, with 25 members attending.

The subject for discussion was "Single-Phase Railways," and a large attendance greeted the speakers of the evening. The papers were limited to 10 minutes in length, and a lantern was provided to assist in the presentation of the subjects under discussion. The papers presented were as follows:

"The Single-Phase Railway System," by Mr. Clarence Renshaw; "The Single-Phase Motor," by Mr. S. M. Kintner; "Catenary Line Construction," by Mr. T. Varney; "A Comparison Between Single-Phase and 1200-volt Direct-Current Systems," by Mr. F. E. Wynne; "The Single-Phase Systems in Operation," by Mr. G. D. Nicoll, electrical engineer of the Pittsburgh & Butler Street Railway Company; "The 1200-volt, Direct-Current System in Operation," by Mr. Harry Etheridge, chief engineer of the Pittsburgh, Harmony, Butler & Newcastle Street Railway Company, Pittsburgh. There was unusual interest shown in the discussion of this subject. Mr. N. W. Storer opened the discussion, and was followed by Mr. James Bryan, consulting engineer, and one of the chief advocates of the 1200-volt, direct-current system. Mr. Bryan's discussion of the subject was in a humorous vein, and the good-natured banter between the advocates of the various systems kept up a very lively interest among those present, and afforded considerable amusement. The other speakers were Mr. W. L. Waters and Mr. B. A. Behrend, of the Westinghouse Electric & Manufacturing Company, and Mr. W. E. Moore, of the West Penn Railways Company.

The next meeting will be held April 6, and will take up the subject of live-line repairs and maintenance, with a view to prevent interruption of service. The principal paper will be presented by Mr. J. S. Jenks, chief engineer of the West Penn Railways Company.

March Meeting of I. E. S., New York Section.

At a meeting of the New York section of the Illuminating Engineering Society, held on March 18, two papers were read. A paper by Mr. Bassett Jones, Jr., dealt with the theory of finite surface light sources. The author treated the subject almost exclusively from the mathematical standpoint. Mr. Albert J. Marshall presented a paper describing the lighting equipment and the illumination of the editorial offices of the New York *World*.

The editorial offices are lighted by means of mercury-vapor lamps and tungsten incandescent lamps. Each lighting unit consists of a mercury-vapor tube 27 in. in length, bent into circular form, surrounding a 100-watt tungsten lamp which is operated in series with the former lamp and serves as its "ballast resistor." The two lamps are placed within a prismatic 16-in. hemispherical reflector. The unit normally consumes 240 watts; the tungsten lamp is rated at 80 cp and the vapor tube at 200 cp.

Tests showed that with 36 units lighting a floor area of 2952 sq. ft., the average illumination was 4.0 ft.-candles. Since each unit consumed 232 watts at the time of the test, the equipment gave an effective output of 1.4 lumens per watt.

Mr. E. L. Elliott explained the fact that the light from the mercury-vapor lamp permits one to distinguish details more readily than does that from any other artificial source by stating that the eye can focus more sharply for monochromatic light than for polychromatic light, for which it must assume merely an average focus that is incorrect for both the longer and the shorter wave-lengths.

The secretary announced that during April the section will hold a joint meeting with the Municipal Arts Society and the National Arts Club at which time the subject of exterior lighting will be discussed. At the May meeting a paper will be read by Mr. Alfred A. Wohlauer dealing with the calculation and design of illumination, and a second paper by Messrs. Hopton and Watkins on the design of lighting fixtures. At the May meeting Mr. Louis J. Auerbacher will present a paper outlining the history of the flaming-arc lamp.

Dinner of Chicago N. E. L. A. Section.

Taking the form of a dinner and social gathering at the Bismarck Hotel, the meeting of the Commonwealth Edison branch of the National Electric Light Association of Chicago, on the evening of March 15, was an enjoyable affair. There were 237 persons present, and Mr. George Harvey Jones, the chairman of the branch, presided, the after-dinner exercises being in charge of Mr. John W. Ferguson, toastmaster, who with Mr. Charles A. Lind and Mr. H. B. Gear constituted the entertainment committee. The program of the entertainment embraced a piano solo by Mr. Michael F. McGovern; songs by Mr. W. R. White and Mr. R. T. Conger and by the N. E. L. A. quartet, consisting of Messrs. T. F. McDonald, Edward Lynch, Thomas J. O'Brien and George L. Ashline. Mr. T. F. McDonald gave a witty monologue, and Mr. J. T. Mountain told about "A Trip Up the Mediterranean," illustrated by lantern slides. Mr. John F. Gilchrist, assistant to President Samuel Insull, made a speech on "Team Work," containing some excellent advice, and then he proposed a song on the same subject (written by himself) which was sung by the entire audience. The burden of this song, in plain prose, is "Above all we want team work, with no single hand withdrawn, to make our company great." The evening's entertainment came to an end by the singing of the national hymn, "America."

The Electrification of Steam Railroads.

At a meeting of the New York Railroad Club, held on March 19, the electrification of steam railroads was discussed. Dr. William McClellan gave a brief history of the development of electric railways and outlined the systems now available for use under steam railroad conditions. He expressed the belief that each system is well adapted for a certain duty. For long-distance work high voltage must be used, both on account of the economical transmission of energy and the unavoidable congestion of load. Dr. McClellan entered a plea for standardization of the locations of the third-rail and overhead contact wires and the over-all clearances.

Mr. W. S. Murray remarked that the time has arrived for steam-railroad and electric-railway engineers to co-operate in the solution of the electrification problem. He claimed that the single-phase system has proved absolutely reliable and satisfactory for long-distance heavy railroad service. As showing the durability of the overhead conductor, Mr. Murray stated that at the present rate of wear the wire will remain in service for considerably more than 50 years. Experience shows that an electric locomotive covers 210 miles per day as compared with 150 miles by steam locomotives in the same service.

Mr. N. W. Storer said that for strictly terminal work the direct-current locomotive is thoroughly satisfactory, but for inter-city work alternating current must be used; three-phase can be employed, but single-phase is far preferable.

Mr. C. L. De Muralt claimed that a three-phase locomotive is much lighter and more reliable than a single-phase locomotive; moreover, its torque characteristics are advantageous rather than disadvantageous for railway service.

Mr. E. B. Katte stated that the reliability of the direct-current locomotive has been shown conclusively by the service on the New York Central, where the average delay is equivalent of one minute for each 3000 miles of travel per train.

Dr. C. T. Hutchinson called attention to the fact that the most powerful locomotives in existence to-day are the three-phase, 2000-hp units of the Great Northern Railroad. Mr. N. W. Storer announced that a 2750-hp single-phase locomotive is now being designed.

Meeting of New England Electric Lighting Engineers.

The seventh annual meeting of the Association of Electric Lighting Engineers of New England was held at Young's Hotel, Boston, on March 18. The first paper was by Mr. F. C. Sargent of the Malden Electric Company on "Series Incandescent Street Lighting." The author related his experience with about 200 32-cp, 6.6-amp tungsten lamps which were installed simultaneously. Of these, in one year 70 burned out, 68 filaments were broken and 90 were broken maliciously. The total hours burned for the period were 3000, giving an average life on the total renewals of 2600 hours. Mr. Sargent referred to the malicious breakage of lamps in suburban communities as a serious problem. He had posted a notice offering $25 reward for the arrest and conviction of anyone maliciously breaking lamps or globes, and within the first month the proportion fell from 60 per cent of the total renewals to 25 per cent, and has since never exceeded an average of 30 per cent. Lamps of from 40 cp to 60 cp, when they can be placed so that the limbs of trees do not obstruct the light, should be not less than 12 ft. above the ground and an average of 15 ft. gives good results.

In conclusion Mr. Sargent compared a "so-called" 60-cp Welsbach mantle lamp with a 60-cp tungsten lamp, based on 4000 hours per year service. A Welsbach lamp with a consumption of 3.5 cu. ft. per hour and a rate of $1 per 1000, will cost $14. Add to this renewals, repairs and labor at 3 cents per night, or $10.95, gives a total cost per year for the gas lamp of $24.95. Assuming $24.95 is the price charged for the 60-cp tungsten lamp for the year and deducting three renewals at $1.10 per lamp per year, or $3.30, leaves an income of $21.65 per year for the tungsten lamp to pay for energy, labor and repairs, as a 60-cp lamp will consume 300 kw-hours in one year, the income of $21.65 is 7.2 cents per kw-hour. If the same comparison is applied for a 40-cp tungsten lamp, the income would be approximately 11 cents per kw-hour. The gas lamp depreciates rapidly in candle-power the first few hours of its life, and does not have the advantages of a variable schedule in operating. Mr. Learned, of Meriden, Conn., said that he had made shadowgraph tests which showed that the 40-cp tungsten is equal to a 60-cp gas lamp. Mr. Cowles stated that the Boston company now has over 5000 series-tungsten lamps in street service. In a few important locations in the suburbs 60-cp lamps are mixed in with the 40-cp units. The company is satisfied that a life of 1500 hours is conservative unless the breakage is excessive. The average malicious breakage in the Boston system is about one-third of the total renewals.

Mr. G. W. Lawrence, of the Greenfield Electric Light Company, presented a paper on "The Magnetite System of Street Lighting at Greenfield, Mass." There are two 4-amp, 50-lamp sets, operated on three-phase, 2300-volt, 60-cycle service. The mercury tubes are now cooled with oil, as the life with air cooling was short. Use is made of a submerged cooling coil requiring about 4 gal. of water per hour. A needle valve is installed for controlling the flow. The best results appear to be at a temperature of about 85 deg. Fahr. to 90 deg. Fahr. The tube is held in a cast-iron oil box, and the horn type of static discharger is used to prevent the tube puncturing from a discharge from air to oil. A tube can be replaced in two minutes. The average life of the parts is as follows, in the company's experience in 1908: Air-cooled mercury tubes, 448 hours; oil-cooled mercury tubes, 1433 hours. Cleanliness, simplicity, absence of revolving parts, low maintenance cost and economy of energy are points of advantage in this system.

Mr. D. A. Harrington, Boston, consulting engineer on underground construction, then presented a paper describing the solid and the drawing-in systems and discussing the advantages of each. He pointed out the methods of making multiple-duct wood conduits, treated for preservation; considered pipe conduit in connection with obstacles in construction; and showed how vitrified conduit has gradually superseded many other forms. The general plans of conduit development were considered and the following figures of average cost of construction per conduit-foot in unpaved streets with conduit of different sizes, including manholes, and using either fiber or clay ducts, were given: Two ducts, $1.50; 4 ducts, $1.90; 8 ducts, $2.60; 12 ducts, $3.10; 16 ducts, $3.60; 20 ducts, $4; 40 ducts, $6.50. In conclusion the paper described the submarine conduit of the Boston Edison Company, which has given good service under Fort Point Channel and under Reserved Channel of Boston Harbor for the past 10 years.

Mr. N. T. Wilcox, of the Stone & Webster interests, then gave a talk on "The Operation of Underground Structures in Moderate-Sized Systems." The address was largely along the line of emphasizing the value of good insulation, including some remarks upon the usefulness of the single-duct type of construction. The tendency of multiple ducts is to require thin walls. Racking manhole cables is good practice, and the use of kyanized cable cleats along the sides of manholes has given excellent results.

In the discussion of these papers Mr. L. L. Elden, of the Boston Edison Company, said that if the company were building another submarine line it would adopt the tunnel form of construction, which could be flooded and then pumped out in case of severe trouble. The cost would be about $15 per running foot. He said that in the company's high-tension cable system there had been 10 breakdowns in a year, this covering 125 miles of cable. Six faults were due to the manufacturer and four to mechanical and electrolytic troubles.

A talk was then given on "Recent Steam Turbine Developments" by Mr. J. R. Bibbins, of the Westinghouse Machine Company, Pittsburgh. Following the address of Mr. Bibbins a paper was read by Mr. C. B. Burleigh, of the General Electric Company, on the "Curtis Horizontal Steam Turbine."

Mr. Burleigh emphasized the large number of horizontal shaft Curtis turbines now in operation, there being in service or under order at present over 800 machines running as high as 3500-kw maximum. Within the past year over 275 machines have been sold. In 1908 over 230,000-kw rating of vertical turbines of this type were sold.

Railway Signal Association.

The quarterly meeting of the Railway Signal Association was held in Chicago on March 15. President L. R. Clausen was in the chair, and, after some opening business, Mr. E. E. F. Creighton, of the General Electric Company, delivered a lecture and demonstration on "Lightning Phenomena." An extensive article on this subject by Mr. Creighton recently appeared in these columns. The afternoon session was devoted to a debate on the question whether the scheme of signaling presented at the Washington meeting of the association in October, 1908, is the best that has been devised. Mr. Elliott, signal engineer of the New York Central Railroad, and Mr. Anthony, assistant signal engineer on the Pennsylvania Railroad, took the affirmative side of the question, and Mr. Stevens, of the Santa Fé, and Mr. Clausen, of the Chicago, Milwaukee & St. Paul, the negative. Mr. Balliet, of the New York Central, was called to the chair.

The debate related to various systems of signaling and after the gentlemen mentioned had used up their allotted time, the discussion became general. Among those who took part in it were Mr. Frank Rhea, of the General Electric Company, and Mr. Sperry, of the General Railway Signal Company, of Rochester, N. Y. By vote it was decided that the negative side had won the debate, but it is to be understood that this vote has no effect whatever upon the adoption of any scheme of signaling by the association. The object of the debate was to call forth a more general expression of opinion concerning the subject of signaling. A committee has been at work for three years in an effort to improve the present practice in railway signaling, and it is expected that the debate at the Chicago meeting will be of great assistance to it.

Meeting of the New England Section I. E. S.

The regular monthly meeting of the New England section of the Illuminating Engineering Society was held at the Edison Building, Boston, on March 16. The speaker of the evening was Mr. J. W. Codman, of Boston, who discussed "The Simplification of Illuminating Engineering Problems Through the Conception of Light Fluxes." The speaker reviewed thoroughly the latest practice accepted in the treatment of these problems, explaining the flux-of-light method of calculating average illumination in terms of the lumen. Lumens per square foot was considered as an expression for illumination identical with foot-candles, and the rough approximation of lumens taken as 10 times the nominal candle-power of incandescent lamps was discussed. A Reflex burner equipped with a Holophane reflector delivers about 200 lumens per cubic foot of gas burned per hour. The method of figuring lumens from the photometric curve was then considered, as well as the proportion of lumens generated which are effective on the plane of illumination. Mr. Codman then discussed the necessity for falling back on the point-to-point method of calculation to secure proper uniformity. The best methods of simplifying work with the point-to-point method by the use of special tables or calculations were also discussed, with the rules for proper spacing of light sources with regard to the height above the plane and the effect on ceiling and wall reflection.

Three tables were presented dealing with the practical use of calculations involving lumens with different light sources and shades, and in connection with a special case of room illumination. In conclusion, Mr. Codman presented a complete bibliography of recent illuminating engineering literature dealing with practical methods of work. Table I gave values for the light intensity in lumens per square foot for various services. Table II gave values of lumens per watt obtained from various lighting equipment; this table differs from the table on page 90 of our issue of July 11, 1908, in that it shows the lumens per watt rather than the watts per lumen. Table III is reproduced herewith:

Room, 24 ft. 3 in. long; 11 ft. 6 in. wide; 10 ft. 1 in. high. Three 40-watt tungsten lamps, close to ceiling. Lumens generated, 933. Test plane, 2½ ft. above floor.

	Mean foot-candles, bare lamps.	Mean foot-candles, reflectors.	Per cent increase due to reflectors.	Lumens effective, bare lamps.	Lumens effective, reflectors.	Lumens effective in per cent of lumens generated, bare lamps.	Lumens effective in per cent of lumens generated, reflectors.	Lumens per watt, bare lamps.	Lumens per watt, reflectors.
Calculated illumination	0.41	0.89	117	113	245	12	26	0.94	2.04
Measured all-dark surfaces	0.48	0.91	90	132	250	14	27	1.10	2.08
Light floor	0.50	0.90	80	137	248	15	27	1.15	2.06
Light walls	0.85	1.15	35	234	316	25	34	1.95	2.64
Light ceiling	0.94	1.17	24	258	322	28	35	2.15	2.68
Light floor and walls	0.92	1.23	34	253	338	27	36	2.11	2.82
Light floor and ceiling	0.99	1.20	21	272	330	29	35	2.26	2.76
Light walls and ceiling	1.57	1.74	10	432	479	46	51	3.60	4.00
All-light surfaces	1.96	2.27	16	540	625	58	67	4.50	5.20

Chicago Subway Report.

An elaborate report has been issued by the local transportation committee of the Chicago City Council, based on the work of the city engineer and a large corps of assistants, relating to the proposed subway for street-railway traffic and other purposes under the streets of the downtown business district. It is proposed to build, ultimately, subways under the principal north and south streets in the center of the city, the subways to be large enough to accommodate four tracks—two for elevated trains and two for surface cars. The estimate is that a four-track subway will cost $3,750,000 a mile, with three-track, two-track and possibly single-track, proportionately less. The increase of population in the city is expected to make subways necessary in all the downtown streets, but at first the work will be confined to one or two north-and-south streets and one or two east-and-west streets. The subways are not intended, the report declares, for high-speed through service, but merely to improve existing service. They are to enable the cars to avoid the congestion of the surface traffic on the streets.

The work of preparing the subway report is said to have cost $75,000. Through routes are declared to be a necessity for the operation of the subway. In the proposed Wabash Avenue subway the South Side cars would enter the subway at Twenty-second and State Streets, leaving it at Orleans and Chicago Avenues and proceed possibly to Evanston. Similarly West Side cars would enter at Blue Island Avenue and Halsted Street, make the loops through State Street and leave at Halsted and Lake Streets and proceed to Austin or Oak Park.

CURRENT NEWS AND NOTES.

LICENSING ELECTRIC CONTRACTORS.—A bill has been introduced in the New York State Legislature providing for the licensing of electrical contractors after an examination by a board consisting of an electrical contractor, electrical worker and electrical inspector and upon giving a bond in the sum of $2,000.

AN ACTRESS AS ILLUMINATING ENGINEER.—In a contract with the owners of a Boston theater Miss Louie Fulller, the actress, provides for the details of electrical illumination, to which subject she states she has given much attention. In an interview she has said that some entirely new methods of electrical illumination will be used, both on the stage and in the auditorium.

DAMAGE TO MESSINA CABLES.—In overhauling the submarine cables, seven in number, between Italy and Sicily, some were found to be badly damaged by heat, the sheathing and layers of rubber being burned and in some cases the copper conductors fused. One of the cables was so deeply embedded, owing to a change in the floor of the Strait of Messina, that it had to be abandoned.

THE PARIS STRIKE.—The report from Paris that the strike of telephone and telegraph operators and postal employees had been brought to a sudden close March 13 seems to have been premature. It has continued throughout the week, but the latest reports indicate that it is practically ended, although some of the more belligerent strikers are endeavoring to prolong the disorder. M. Simyan, Under Secretary of Posts and Telegraphs, seems to have been the thorn in the flesh of the strikers, and the settlement of the trouble centers upon his dismissal or elimination.

NEW YORK ELECTRICAL SOCIETY AT THE HIPPODROME.—The 284th meeting of the New York Electrical Society will be held at the New York Hippodrome, Forty-fourth Street and Sixth Avenue, Wednesday, March 31. A special section of the house has been reserved for the members at $1 per ticket. After the performance a meeting of the society will be held on the stage, and Mr. Arthur Williams, of the New York Edison Company, will give an address on "The Electrical Equipment of the Hippodrome." Those intending to be present should advise the secretary not later than Monday, March 29, stating also the number of friends by whom they will be accompanied.

CAPITOL SUBWAYS.—The experience with the subway in Washington between the Capitol and the Senate Office Building has been so favorable that it is proposed to connect the former by subways not only with the Representative Office Building, but also with the Union Station, the Government Printing Office and the proposed new city postoffice. The cost is estimated as about $500,000. Superintendent Woods recommends that the underground passages be equipped with either a narrow-gage railroad or a monorail system, either to be operated by electricity. In his estimates he fixes the cost of the former at $18,600, while the latter could be furnished for $14,000. The Senators use two automobiles of peculiar make in the subway leading to the Senate Office Building.

LIGHTING RAILROAD TRAINS.—The University of Wisconsin has issued a bulletin of its engineering series on the subject of railroad train lighting, the author being Mr. Edward Wray, an electrical engineer of the class of 1906.

ILLUMINATING ENGINEERING SOCIETY.—At the March meeting of the council of the society it was announced that the total membership to date exceeded 1000 by 39, with 14 applications on file. A committee consisting of Prof. H. B. Dates, Dr. E. P. Hyde, with Mr. S. E. Doane as chairman, was appointed to arrange for starting a Cleveland section.

ENGINEERS' LECTURES.—Among recent lectures before the engineering students of Wisconsin University were one by Mr. M. C. Rorty, general commercial superintendent of the Pittsburgh Telegraph Company, on "Major and Minor Tactics of Business," and another by Prof. C. F. Burgess on "The Importance of Chemistry to Future Engineering Development."

BUREAU OF STANDARDS APPOINTMENTS.—The United States Civil Service Commission announces an examination on April 21 to fill 10 or more vacancies in the positions of laboratory assistant in physics and assistant physicist in the Bureau of Standards, at salaries varying from $900 to $1,200 per annum for laboratory assistant, and from $1,400 to $1,800 per annum for assistant physicist.

MUNICIPAL HEATING PLANT.—Jamestown, N. Y., has a municipal electric and water-works plant, and the possibility of operating a municipal heating plant in connection with it, utilizing exhaust steam, is under consideration. If the plan is adopted, the plant will be one of the first municipal heating plants in the Eastern States, although there is a small installation of this character in Webster City, Iowa. Two projects are under discussion in Jamestown, one to cost about $100,000 and one about $30,000 or $40,000.

ELECTRICITY POPULARIZED.—We clip the following from the *Saturday Evening Post:* "The electricity is furnished by the generator in varying quantities—sometimes more, sometimes less. But the transformer acts like a funnel, the current coming out of it always in a stream of a certain size. This, of course, is a matter of utmost importance, inasmuch as the electric 'fluid' could not be utilized satisfactorily for lighting, for running machinery, or for any other purpose, if the quantity of it delivered were constantly varying."

TRACTION PROBLEM IN NEW YORK CITY.—Theodore P. Shonts, president of the Interborough Rapid Transit Company, asserts that the traction lines of New York City—subway, elevated and surface—are called upon to provide, each year, for the transportation of 40,000,000 more passengers than the year previous. The increase of this number of passengers each year is in reality only a growth of about 4 per cent, but it adds $2,000,000 a year to the earnings of the traction lines and requires a continuous increase of facilities.

CANADIAN STATE TELEGRAPH LINES NOT PROFITABLE.—According to a report presented to the Dominion Parliament at Ottawa, Ont., Can., the telegraph lines in Canada owned by the Government are far from profitable. The annual statement shows receipts of $122,432.53, while the expenses amounted to $386,567.34. In Yukon and northern British Columbia considerable difficulty is experienced through snow slides, rock slides, blizzards, etc., and a proposition is under consideration to install wireless systems where wire trouble is most prevalent.

A. I. E. E. NOMINATIONS.—The directors of the American Institute of Electrical Engineers have made the following nominations for officers to be elected at the annual meeting in May: President, Mr. L. B. Stillwell, New York City; vice-presidents, Messrs. J. J. Carty, New York City; Paul M. Lincoln, Pittsburgh; Paul Spencer, Philadelphia. Managers, Messrs. A. W. Berresford, Milwaukee; W. S. Murray, New Haven; H. H. Norris, Ithaca; S. D. Sprong, New York. Treasurer, Mr. George A. Hamilton, New York City. Secretary, Mr. Ralph W. Pope, New York City.

WIRELESS FOR THE ORIENT.—Representatives of the United Wireless Company recently sailed from Seattle in connection with a project to establish wireless telegraph stations in the Orient. They will first visit China and Japan, and later will tramp over the rough Siberian country. According to the plans, a chain of wireless stations will be established from Vladivostok to Aden. The stations will resemble those now in use in the United States, and will communicate with the numerous steamships plying in the Pacific trade, as practically every trans-Pacific line has adopted the wireless system.

PRINTING-PRESS CONTROL PATENTS.—In the operation of printing presses, which in practice must be frequently stopped, and started, and jogged a few inches at a time, it has gradually become the universal custom to make and break the circuit at a separate contactor switch which is electrically controlled by the movement of the hand-controlled rheostat operating lever. Three patents recently issued to Mr. H. Ward Leonard, and based upon an application filed more than eight years ago, relate to basic features of this system of control. The several patents contain 78, 48 and 21 claims, respectively.

INDUSTRIAL ENGINEERING.—Mr. F. A. Lindberg, with George M. Brill, consulting engineer, addressed the Armour Institute of Technology branch of the American Institute of Electrical Engineers in Chicago on March 18, his subject being "Industrial Engineering." The speaker described what is required in the way of engineering for a manufacturing plant, dwelling on the lighting, power, heating, ventilation and fire protection of the modern factory. The lecture was illustrated by lantern slides, showing features of several new industrial plants. Prof. John E. Snow presided at the meeting.

PROPOSED ELECTRICAL DEVELOPMENT IN THE FAR WEST.—It is proposed to extend the transmission system of the Nevada-California Power Company from Tonopah to Ely, Nev., a distance of 150 miles, or 314 miles from the hydro-electric plant at Bishop's Creek. The Forest Service has granted permission to this company to run second transmission lines through Silver Canyon in the White Mountains. The California Electric Generating Company has been organized to build a steam electrical generating plant at Oakland, Cal., to be operated in connection with the Great Western hydro-electric power plant on the Feather River. The Siskiyou Electric Light Company, of Yreka, Cal., proposes to build a 60,000-hp hydro-electric plant at Ward's Canyon, on the Klamath River.

"WIRELESS" FOR LAKE MICHIGAN BOATS.—The four passenger steamboats comprising the fleet of the Graham & Morton Transportation Company, operating on the southern part of Lake Michigan, are now being equipped with wireless telegraph supplied by the United Wireless Telegraph Company of New York. The boats to be equipped are the *City of Chicago, City of Benton Harbor, Puritan* and *Holland.* There will also be land "wireless" stations at Chicago, Ill.; Holland and Benton Harbor, Mich. On the boats the top of the antenna masts will be about 60 ft. above the water. There will be an operator on each boat and at each land station. Key instruments are used, with the Morse code. The "wireless" stations, both on land and on shipboard, will have public offices for the use of the passengers, being also available, of course, for emergency use in navigation if necessary. The charge for transmitting "wireless" messages for passengers will be 50 cents for 10 words. Between "wireless" stations on land, the rate will be the same as the regular Western Union rate.

High-Tension Equipment and Control of Waterside Station No. 2 of the New York Edison Company.

THE generating equipment in Waterside Station No. 2 at present consists of two 7500-kw, 25-cycle, and two 7500-kw, 60-cycle, Westinghouse turbo-generators; six 8000-kw, 25-cycle, General Electric turbo-generators which are being rewound for 10,000 kw; one 14,000-kw, 60-cycle, General Electric turbo-generator, and another of the same rating, but built for a frequency of 25 cycles, is being erected. All of the generators are three-phase machines wound for 6600 volts in the case of the 25-cycle machines, and 7500 volts in the case of the 60-cycle machines, and operate at a speed of 750 r.p.m., making the 60-cycle machines 10-pole, and the 25-cycle machines 4-pole. The rating of the 8,000-kw units and the 7,500-kw units is nominal, the former units carrying 14,000 kw at times. As the leading illustration in the March 11 number shows, the Westinghouse units are arranged in tandem; the 25-cycle machine being next the turbine, and the 60-cycle generator at the end; both being driven from a common shaft. It was not intended that the turbine should be of such a size as to drive both alternators under full load at the same time. In practice two 60-cycle alternators or two 25-cycle alternators are run under full load with the others running light or any three generators can be run at once. When the 25-cycle generator is in operation the other generator operates at a frequency of 62½ cycles. It is not desirable to operate the two 25-cycle and the two 60-cycle units in parallel and thus to tie both systems so solidly together. Moreover, in the present instance, it is not possible to do so, since there is a relative total mechanical displacement of the field structures of about 20 deg. measured on the 60-cycle sides. The double unit combination possesses an advantage, however, in that should the turbine become inoperative for any reason, the coupling between the 25-cycle alternator and the turbine could be disconnected and one alternator driven by the other operating as a synchronous motor.

Once a turbine is started and the throttle opened wide, its control passes from the engineer to the switchboard operator. Each turbine governor is equipped with a small motor, by means of which its speed is altered for synchronizing or for dividing load. This motor is controlled from the switchboard. The field rheostats of the alternators are also operated electrically from the high-tension switchboard. The rheostats are located on the exciter floor. The field switch has opening and closing magnets and discharge coil, and a ¼-hp series motor is used to cut in grid resistance units, or vice versa. The exciter bus switches are closed by hand on written instructions from the high-tension switchboard operator to the operator at the exciter board on the main floor. A telautograph is used for transmitting these written orders, supplemented by a telephone in case of emergency.

Fig. 2 shows a cross-sectional elevation through the electrical galleries, which occupy the Fortieth Street side of the station. The high-tension cables from the armature of the turbo-generators pass through brass pipes to ducts in the turbine room floor and thence up through vitrified ducts in the division wall to the main oil switches located on the fourth mezzanine floor. The high-tension feeder switches here are placed in two rows back to back, and the corresponding pairs of outgoing feeders are designated by group numbers. Both walls are provided with ducts so that the feeder cables pass down both sides and cross over on the basement floor, as indicated in the engraving. The usual precaution of running feeders to the same substation by means of independent routes is employed. Widely separated substations are fed from the two feeders making up one group, and no substation is supplied exclusively by feeders from a single section of Waterside bus. In order to protect the generator, and also the system, from

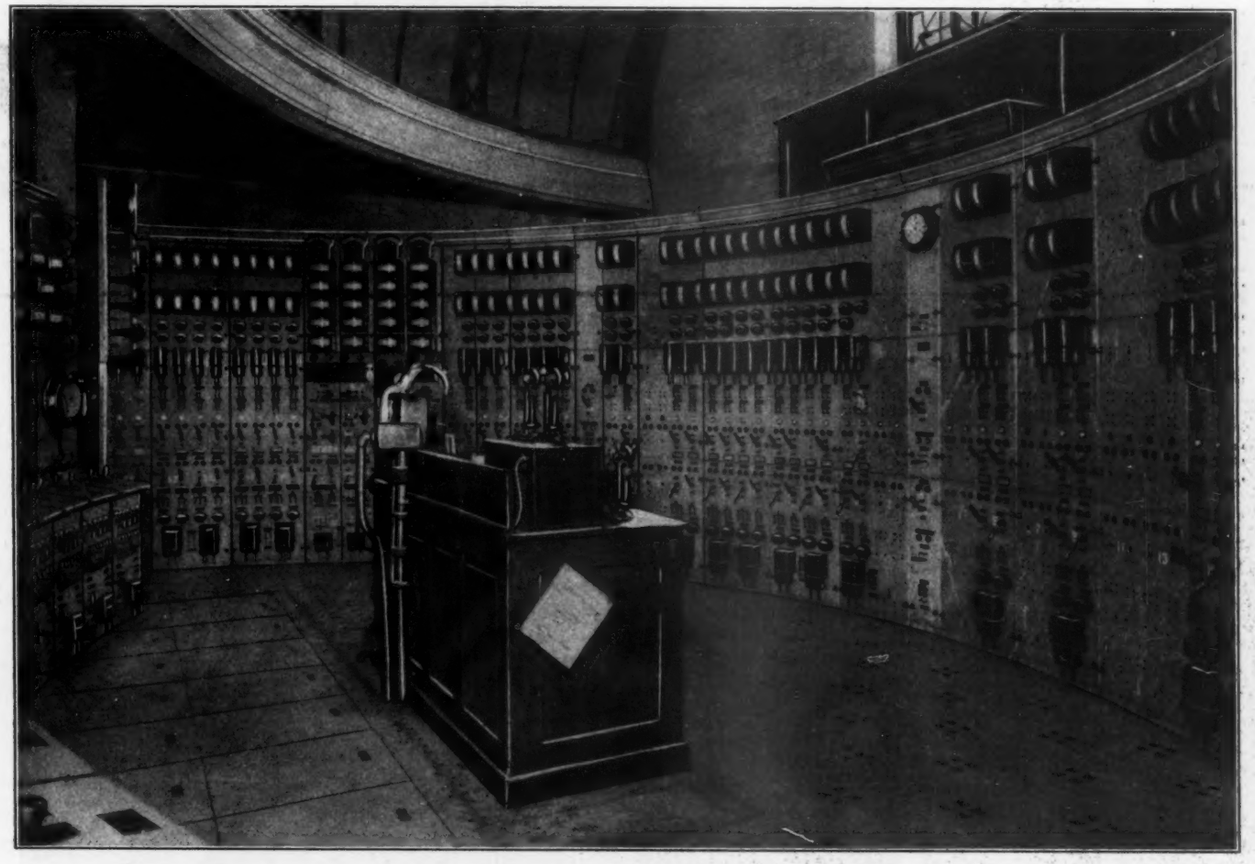


FIG. 1.—GENERAL VIEW OF HIGH-TENSION CONTROL BOARD IN WATERSIDE STATION NO. 2.

hazardous short-circuit conditions, reactance coils are placed on the fifth mezzanine floor to supplement the reactance of the turbo-generators and thus to limit the current given out by the generators under short-circuit. The first, second, third, and fourth mezzanine galleries are divided into four sections by stairways. The third mezzanine floor contains the series

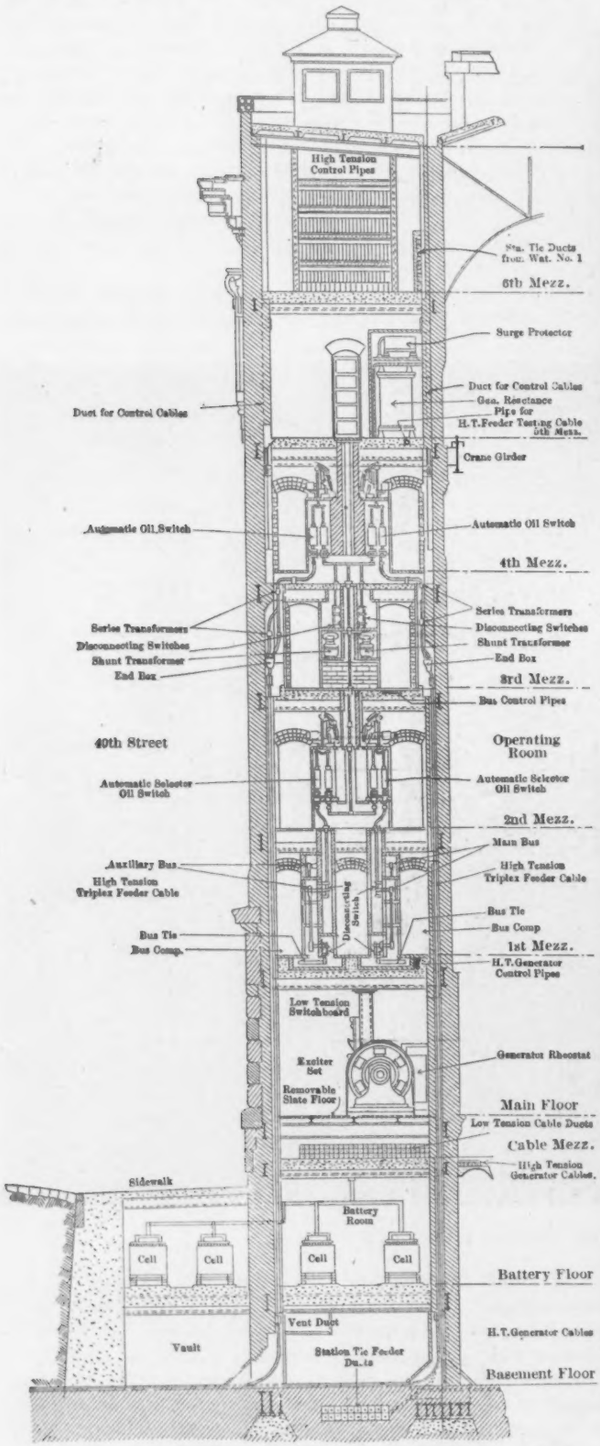


FIG. 2.—CROSS-SECTIONAL ELEVATION OF ELECTRICAL GALLERIES.

and shunt transformers for the instruments, etc. The selector oil switches are housed on the second mezzanine floor and the high-tension and auxiliary buses are placed on the first mezzanine floor. All of the switches are of the remote-control type, operated from the high-tension switchboard gallery at the west end of the operating room. The cables to the various switches, transformers, etc., are distributed through a control pipe run, which rises to the sixth mezzanine floor and occupies all of this floor.

HIGH-TENSION CONTROL BOARD.

For ease of control and compactness of apparatus the high-tension board of Waterside Station No. 2 is probably without

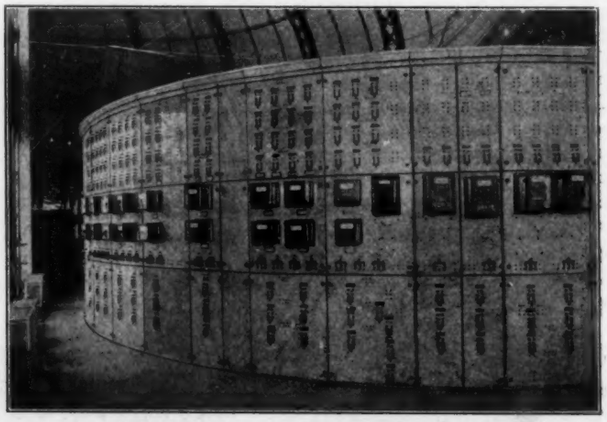


FIG. 3.—REAR VIEW OF FEEDER CONTROL BOARD.

a peer. The control board is located in an enclosed gallery, from which all of the generating machinery is visible.

The generator panels and feeder panels are arranged in the arc generator panels and feeder panels are arranged in the arc of a circle with panels also on the reverse side of the arc. The latter are equipped with meters, testing switches, etc. The feeder panels face the generator panels and are shown in Fig. 1 herewith. The generator panels for the 25-cycle units are shown in Fig. 6; the 60-cycle generators being controlled from panels

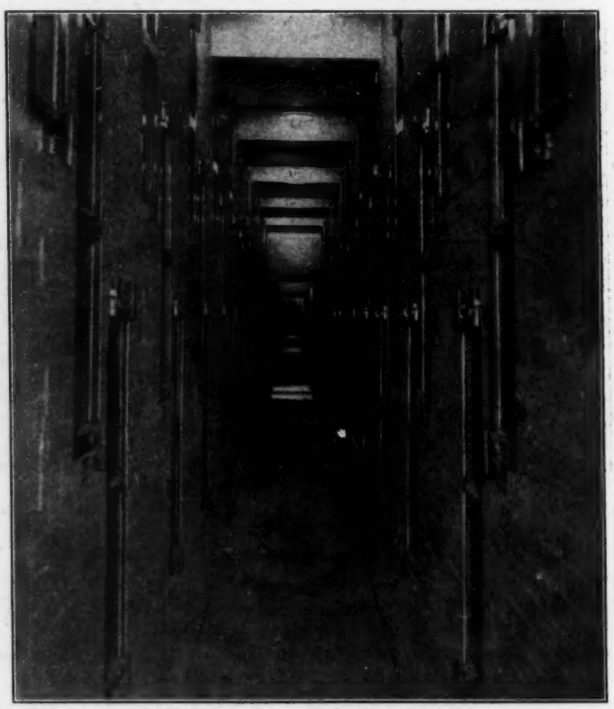


FIG. 4.—HIGH-TENSION BUS GALLERY SHOWING BUS DISCONNECTING-SWITCH COMPARTMENTS.

near the ends of the feeder panels. The 25-cycle generator control panels are of the bench-board type, and in operating the pilot switches the attendant faces the turbine room below which is in direct line of vision. In the lower range of vision are the pilot switches and tell-tale lamps, while in the upper range

of vision are the instruments and return signals from the turbine room below. The switchboard attendant thus not only is cognizant of conditions from instruments and signals in front of him, but can also see the operating machinery and detect mechanical troubles with greater promptness than by surveying

FIG. 5.—GALLERY WITH SHUNT TRANSFORMERS.

a multiplicity of instruments which might not indicate any trouble until a few seconds later.

The high-tension bus is in duplicate, main and auxiliary, each of which is in four sections. A typical diagram of high-tension

FIG. 6.—CONTROL BOARD FOR 25-CYCLE ALTERNATORS.

circuits is illustrated in Fig. 7, which shows the connections of a 60-cycle high-tension generator. A wiring diagram of a 60-cycle high-tension feeder is given in Fig. 9, and, Fig. 10 is a diagram of high-tension station tie connections. These diagrams are self-explanatory. The four bus sections are tied together by two 1,500,000 circ. mil cables in each phase, and the oil switches located in these circuits are controlled by their bus tie sections in the feeder board. The oil switches are of the triple-pole, single-throw type, rated at 2,000 amp and 6,600 volts. They are operated by non-automatic 220-volt motors,

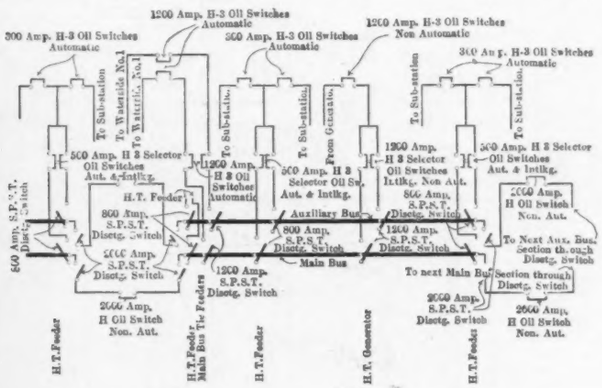

1200 Amp. H-3 Oil Switches Automatic
1200 Amp. H-3 Oil Switches Non Automatic
300 Amp. H-3 Oil Switches Automatic
600 Amp. H-3 Oil Switches Automatic
300 Amp. H-3 Oil Switches Automatic
To Sub-station
To Waterside No. 1
To Waterside No. 1
To Sub-station
To Sub-station
From Generator
To Sub-station
To Sub-station
600 Amp. H 3 Selector Oil Switches Aut. & Intlkg.
1200 Amp. H 3 Oil Switches Automatic
600 Amp. H 3 Selector Oil Sw. Aut. & Intlkg.
1200 Amp. H 3 Selector Oil Switches Intlkg. Non Aut.
600 Amp. H 3 Selector Oil Switches Aut. & Intlkg.
H.T. Feeder
800 Amp. S.P.S.T. Disctg. Switch
Auxiliary Bus
800 Amp. S.P.S.T. Disctg. Switch
1200 Amp. S.P.S.T. Disctg. Switch
2000 Amp. H Oil Switch Non. Aut.
To Next Aux. Bus Section through Disctg. Switch
5000 Amp. S.P.S.T. Disctg. Switch
Main Bus
1200 Amp. S.P.S.T. Disctg. Switch
To next Main Bus Section through Disctg. Switch
2000 Amp. S.P.S.T. Disctg. Switch
2000 Amp. H Oil Switch Non. Aut.
2000 Amp. H Oil Switch Non. Aut.
H.T. Feeder
H.T. Feeder Main Bus Tie Feeders
H.T. Feeder
H.T. Generator
H.T. Feeder

FIG. 7.—TYPICAL DIAGRAM OF HIGH-TENSION CIRCUITS.

and have oil pots in separate brick cells. These switches are located on the first mezzanine floor. The high-tension buses are made up of copper straps separated from each other ⅛ in.; the copper straps being 4 in. wide x ⅛ in. thick. The two middle sections of the buses have six straps and the end sections four straps.

The high-tension buses in Station No. 2 are tied with the corresponding buses in Station No. 1 by means of 1,000,000 circ. mil lead-covered cables, with two oil switches in each circuit. The oil switches are rated at 1200 amp. It will be noted in the feeder diagram that the selector switches connect to a common point to which two 300-amp switches are connected, one for each feeder of the group. The purpose of this arrangement is to have always two oil switches in series on every connection to the bus and still permit a selection of buses without the use of open-air hook type switches. There is a total of 75 single feeders in Waterside Station No. 2, and each is equipped with an inverse-time-element overload relay.

The control circuit connections of the main feeder switches differ slightly from general practice. In Waterside Station No. 2 the wiring is so arranged that the tell-tale lamps perform two functions—they indicate the position of the switch and also the continuity or lack of it, in the relay and switch operating circuits. With the lamp burning, it is a positive indication to the operator that the relay and control circuit, including the armature, fields and clutch of the oil-switch operating motor, is in perfect condition. An ammeter is placed in circuit with the series transformer and coil on the alternating-current side of the relay so that any fault here would be indicated by the non-indication of the meter. While this arrangement calls for additional control wires, the ability to tell at a glance whether the circuit is in operating condition or not compensates for the additional expense involved. Without these precautions it would be necessary to make tests from time to time, or wait until the fault made itself known by the non-operation of the circuit.

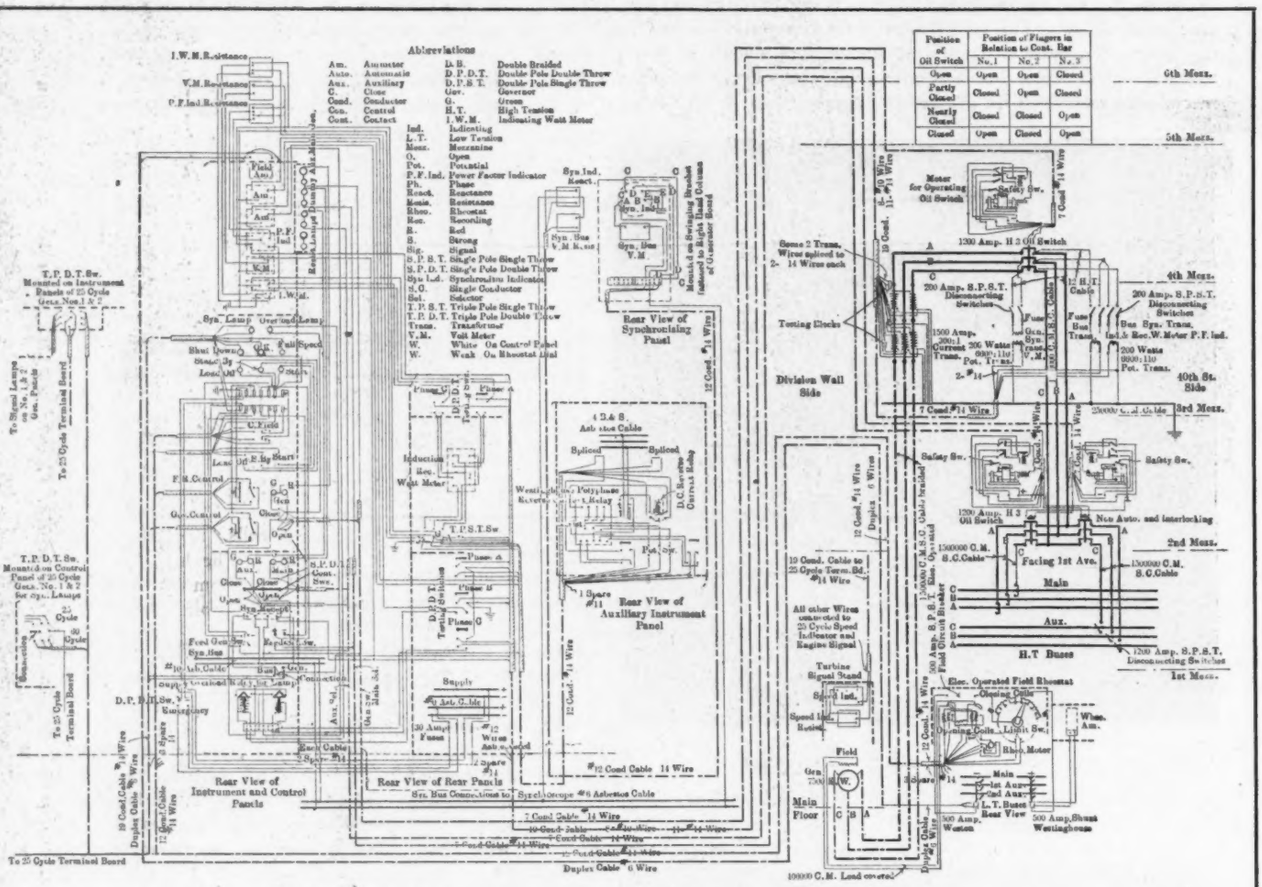


FIG. 8.—DIAGRAM OF CONNECTIONS OF 60-CYCLE HIGH-TENSION GENERATORS.

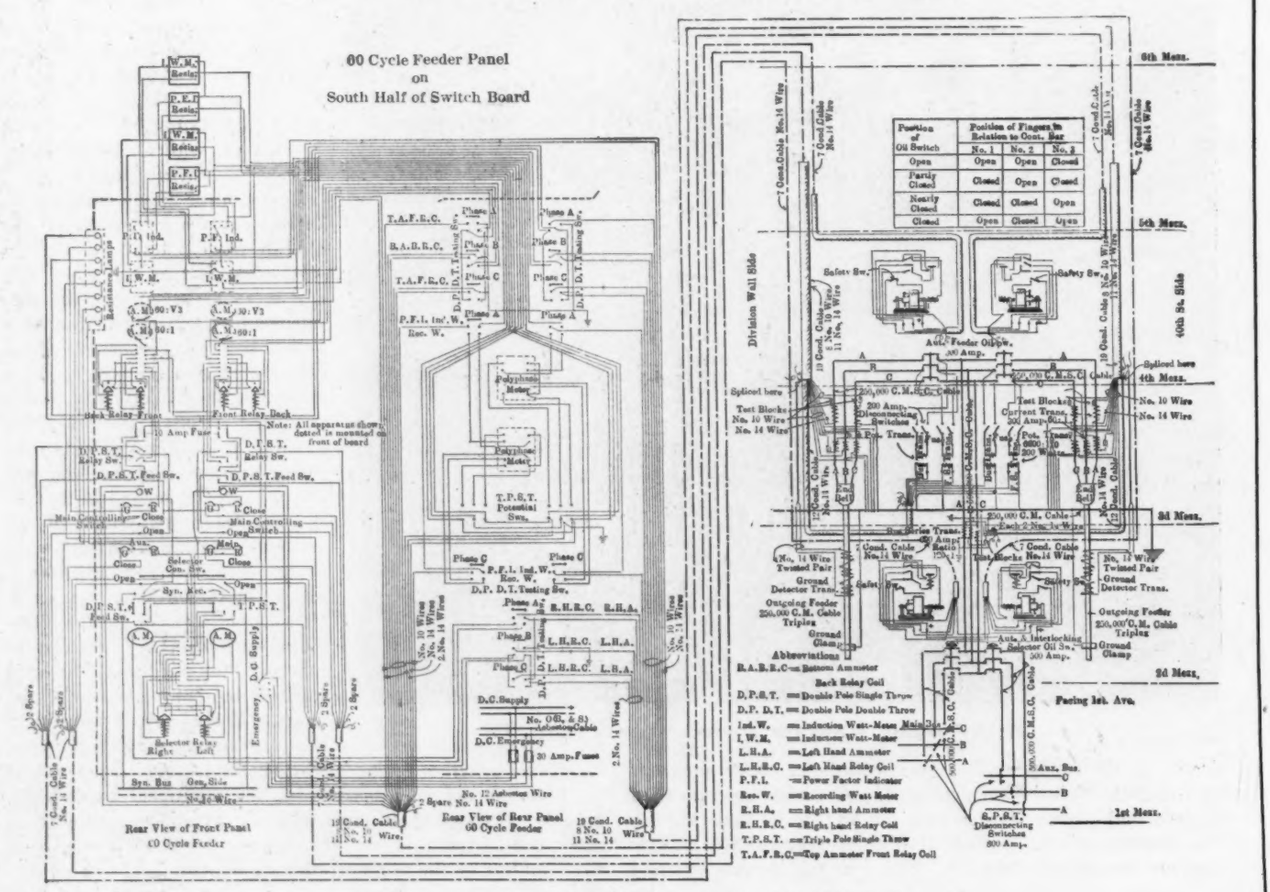


FIG. 9.—WIRING DIAGRAM OF 60-CYCLE, HIGH-TENSION FEEDER.

HIGH-TENSION EQUIPMENT AND CONTROL, WATERSIDE STATION NO. 2.

The high-tension feeder control board has 56 panels on each side of the arc, or 112 in all. The generator control board has 15 panels. All the relays and instruments are provided with permanent switches in series, so that if necessary they may be readily adjusted and checked while the circuits are in service. A permanent feeder testing set forms part of the equipment.

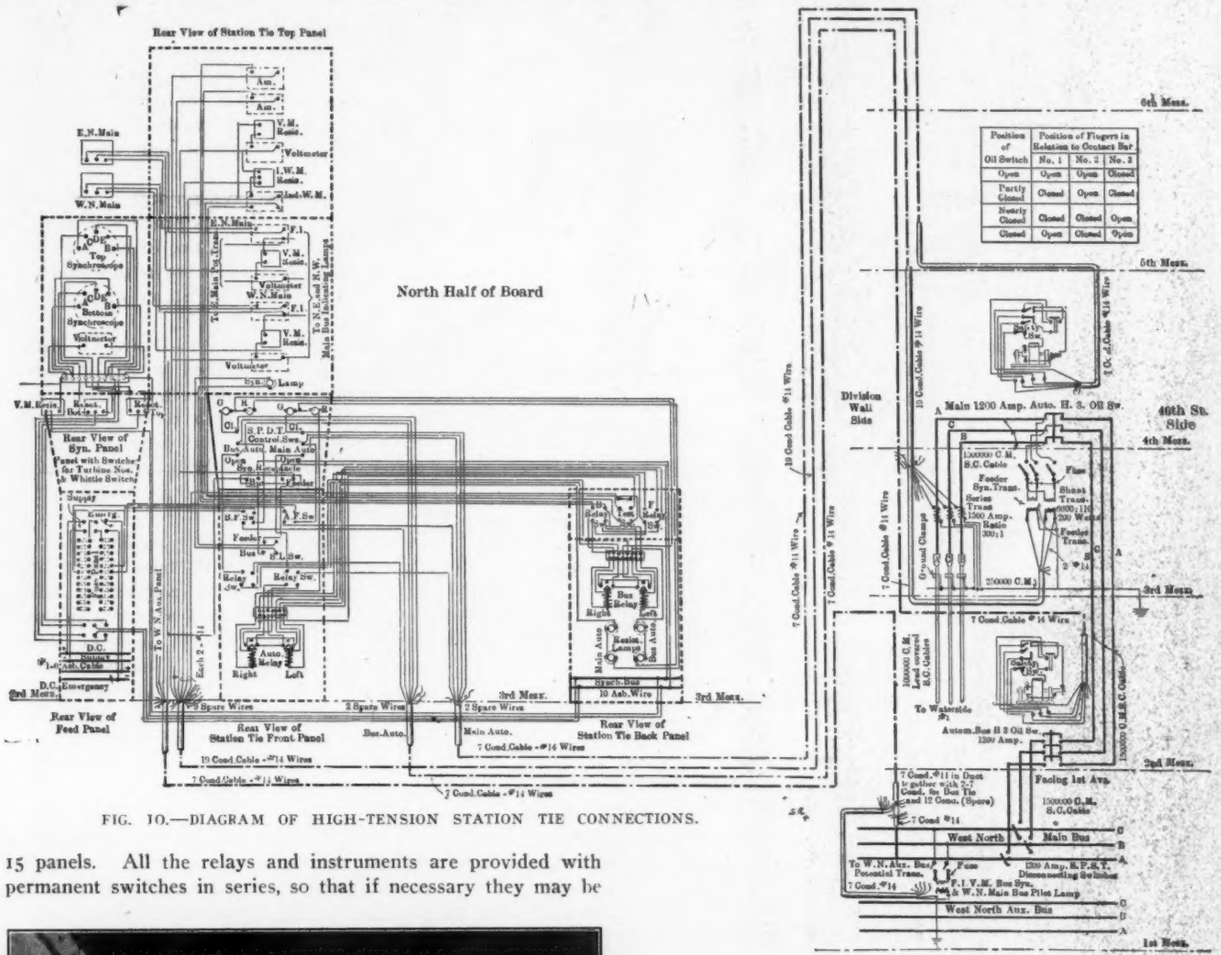

Rear View of Station Tie Top Panel
North Half of Board
Rear View of Syn. Panel
Rear View of Feed Panel
Rear View of Station Tie Front Panel
Rear View of Station Tie Back Panel
6th Mezz.
5th Mezz.
4th Mezz.
3rd Mezz.
2nd Mezz.
1st Mezz.
40th St. Side
Division Wall Side
Main 1200 Amp. Auto. H. S. Oil Sw.
West North Main Bus
West North Aux. Bus
Facing 1st Ave.

FIG. 10.—DIAGRAM OF HIGH-TENSION STATION TIE CONNECTIONS.

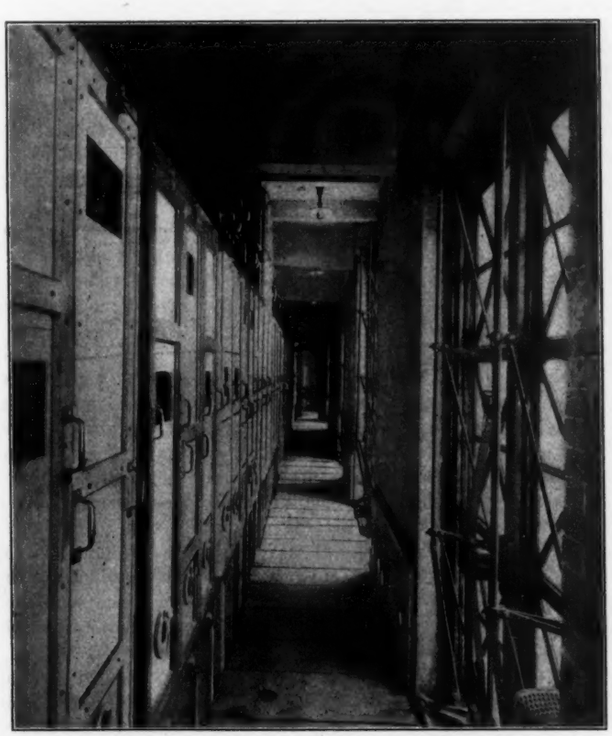


FIG. 11.—AUTOMATIC OIL SWITCHES CONTROLLING FEEDERS.

so that a high-pressure break-down test can be applied to outgoing feeders. A schematic diagram of connections is shown in Fig. 12. A 25-cycle high-tension feeder is passed through a step-down transformer, giving a secondary voltage of 200. By means of a three-phase induction regulator this voltage may be varied between 0 and 400 volts, while three fixed resistances limit the current in case of break-down of feeder insulation. The circuit is also opened by an automatic triple-pole switch, which, in closing, passes the circuit through a step-up transformer to voltages varying from 7500 to 26,000, depending on the connections. This high-pressure circuit, in which are three electrically operated switches, is conveyed to testing stations on the fourth mezzanine floor through a special

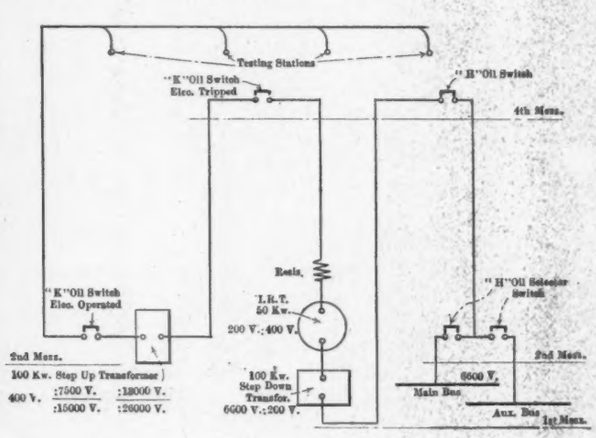


FIG. 12.—TYPICAL DIAGRAM OF FEEDER TESTING CIRCUITS.

50,000-volt triplex cable. Connection is made between the testing station and the feeder to be tested by means of flexible cables and bayonet switches. In operation the selector oil switches are thrown by the operator at the high-tension control board. The feeder switch is operated from the feeder testing board, and when closed brings three-phase 200-volt current on the feeder testing board. This is changed in potential from 0 to 400, as previously outlined. The tests usually made are "copper-to-copper" test on all new feeders and on all feeders upon which work has been done. A copper-to-ground test may be made by simply throwing in the neutral of the secondary of the step-up transformer. The test voltage is 7500 volts. On generator cables the test voltage is 15,000. Banks of lamps and an artificial neutral resistance are also provided for testing out the phases of any feeder.

Mounted on top of the feeder control board is a feeder ground indicator. This device was designed by the New York Edison Company. On each of the outgoing feeders are placed three special series transformers. Any unbalancing of one of the feeders, caused by a ground, will induce currents in these series transformers, which in turn energizes a telephone drop in the indicator; a shutter being tripped having the number of the feeder. This action closes an alarm circuit as well as short-circuiting the main telephone drop coil. A condenser intensifies the actuating current of the transformer.

Telephone Conversations as Viewed by the Courts.

By Francis W. Lane.

THOUGH the telephone has been in existence for some 30 years as a medium for the carrying on of business transactions, it is only within a very few years that its use has become so well-nigh universal that the courts have been asked to pass upon the weight as evidence of a conversation carried on by this means. The validity under certain conditions of telephone conversations as evidence has been recognized in several States to a far greater extent than in New York, but a recen decision of the Appellate Term of the Supreme Court of that State, First Department, determines the status of such conversations so clearly that the matter becomes one of considerable interest both from the legal point of view and from the po ition of the public and the telephone companies.

Reference is made to a decision in the case of Rimes vs. Carpenter et al., reported in the *Law Journal* of Jan 29, 1909, as rendered by Justice Bischoff, on appeal from the Municipal Court of the city of New York. Briefly, the facts were these: The issue related to certain orders given by the plaintiff's wife, with his authority, to the agent of the defendants, who were brokers. The defendants offered proof as to what was said in this conversation in the form of the testimony of a person who had listened to the conversation over another telephone in the defendant's place of business, but was listening in another room.

The lower court ruled out this evidence and that of the identity of the speaker as the plaintiff's wife or evidence tending to show that the conversation which was overheard was the same as that covered by the plaintiff's testimony. This decision was given on the ground that the evidence was incompetent for the reason that the conversation was heard over another instrument and in another room.

In reversing the lower court the appellate judge said:

"Unquestionably a conversation overheard between parties whose voices are recognized by the witness may be proved, and there is no ground for distinction in principle between such a case and that of a conversation by telephone, which the witness overhears, where the actual connection between the instruments is shown in such wise as to identify the very conversation, and the persons holding the conversation are known. From the proceedings upon the trial it appears that the defendants could probably have shown, but were not permitted to show, that three instruments on the same wire being used by the principals in the conversation and by the person who overheard it, would serve as a medium of transmission whereby what was heard by one listener must have been heard by the other and have been the actual words of the speaker. In this situation the conversation overheard by a witness would clearly be the proper subject of his testimony, where the conversation itself, as between the parties, is competent and relevant to the issues."

All the justices concurred in the decision and in view of the fact that it marks a reversal of previous practice in the State of New York and conforms to the practice of other States in which similar cases have been decided, it seems to establish the probable future practice in the United States on fairly firm grounds.

In a somewhat similar case in Missouri—Wolfe vs. Missouri Pacific Railway, 97 Mo., 473, 481—quoted by *Bench and Bar* for January, 1908—a witness for the defendant was allowed to testify to a telephone conversation with some person in the plaintiff's private office, although he was unable to state that such person was either one of the plaintiffs or their clerk. In approving the admission of this testimony, the Supreme Court said:

"The courts of justice do not ignore the great improvement in the means of intercommunication which the telephone has made. . . . When a person places himself in connection with the telephone system through an instrument in his office he thereby invites communications, in relation to his business, through that channel. Conversations so held are as admissible in evidence as personal interviews by a customer with an unknown clerk in charge of an ordinary shop would be in relation to the business there carried on. The fact that the voice at the telephone was not identified does not render the conversation inadmissible."

In this case, as well as in one decided by the Supreme Court of Illinois, in which the Missouri case was cited—Godair vs. National Bank, 225 Ill., 572, 574—it was clearly stated that while evidence of the telephone conversation was admissible to the case, the weight of such evidence was for the jury to determine.

The question of identity is the only important one involved, and it appears probable that in all future similar cases evidence upon this point will be admitted, but its weight must be left to the determination of the jury. What may constitute the establishment of identity is suggested in a case decided by the Kentucky Court of Appeals—Holzbauer vs. Sheeny, 104 S. W. Rep., 1038. The court said:

"Obviously the speaker whose conversation is introduced as evidence of an admission against his interest must be identified in some proper manner by evidence as the party to be charged in the suit, or the conversation cannot be received against him.

"If the witness was acquainted with the defendant's voice, his testimony that he recognized her voice is admissible as evidence, and it may constitute proof of her identity, or the identity might be proved otherwise. In average experience the numbers and addresses contained in the telephone company's directory for public use are found sufficiently accurate to justify its substantial trustworthiness. When, therefore, a person so stated to live at the address, and bearing the same name as the party sought to be charged, is called for by the telephone at that number and address, and answers to the name, admitting the identity, it is to be accepted as the same evidence would be if the witness testifying had called in person and the ostensible owner had answered and admitted the identity."

In view, therefore, of the position just assumed by the Supreme Court of the State of New York and of that previously taken by the courts of the States whose decisions have been referred to, it appears that the telephone is coming to be as fully recognized by the courts as a necessary and reliable agency in the transaction of business as it has long been recognized by business men themselves.

A Quick Method for Determining Sags and Tensions in Transmission Lines.

BY H. J. GLAUBITZ.

IN connection with the design of certain special towers for wireless telegraphy, in which numerous guys, together with the tower, act as the aerial capacity, the necessity arose of finding a quick method of determining the sags and tensions in the guys at different temperatures. A special case of this problem is the determination of sags and tensions in transmission lines, and as this is of more general interest there will be described below an analytical method of finding these sags and tensions quicker than the graphical one generally employed. Mr. A. J. Bowie, Jr., has written some admirable papers, which appeared in the *Electrical World* during 1906, on the same subject; while his method is similar to that given below, the expressions are too involved to admit of readier solution of the problem than by the graphical method. Particularly, much complication is avoided by the use of the diagram of maximum wind-pressures, as shown in Fig. 1. The wind-pressures as given therein are in accordance with the best American and European practice for the design of high towers. It will be noted that, as is actually the case, the wind-pressures increase with the height above the ground, which by the way, is a very important consideration in the spacing and proportioning of guys for guyed structures, as the axis of

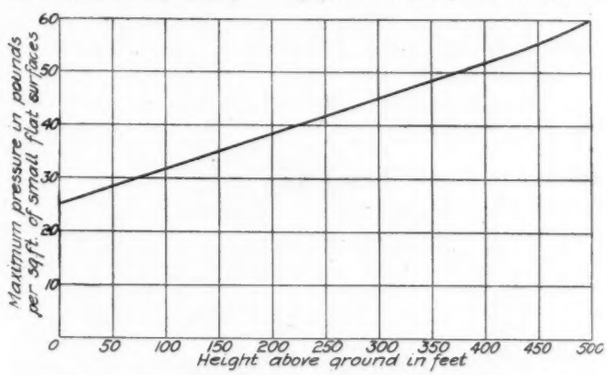


FIG. 1.—VARIATION IN WIND-PRESSURE WITH HEIGHT.

the latter, when under wind-stress, should conform as nearly as possible with a straight line.

Let the problem be as follows: With a span of 1000 ft., a temperature of 70 deg. Fahr. and no wind blowing, find the deflection and tension which must be allowed in installing a 350,000-circ. mil hard-drawn copper cable so that when the wind-velocity increases to its maximum, the temperature drops to + 20 deg. Fahr., and the cable is uniformly coated with a layer of ice 0.25 in. thick, the cable will not be strained more than 30,000 lb. per square inch; or, in other words, will have a factor of safety of at least 2.

As the cable will probably have to clear the ground by 25 ft. during maximum deflection it will be safe to assume the mean height of the cable above the ground to be 40 ft. Fig. 1 gives for this height a maximum wind-pressure of 27.6 lb. per square foot of flat surface, or of 13.8 lb. per square foot of projected cylindrical surface, which means a wind-pressure on the ice-coated cable of 1.357 lb. per lineal foot. The weight of the 0.25-in. ice coating (at 59 lb. per cubic foot) would be 0.299 lb. per linear foot.

Let

A = area of cross-section of cable = 0.2749 sq. in.

w = weight per foot of cable itself = 1.076 lb.

W = maximum total load per linear foot on cable, resulting from weight of cable plus the weight of ice acting vertically, and the wind-pressure acting horizontally = 1.933 lb.

M = modulus of elasticity of material = 16,000,000.

y = one-half the length of the span of the cable = 500 ft.

k = thermal coefficient of linear expansion of cable = 0.0000096 per degree Fahr.

d = range of temperature below that of installation = 70 — 20 = 50 deg. Fahr.

T = maximum allowable tension = 30,000 lb. per square inch.

x = deflection in feet of center of cable when under maximum stress.

x' = deflection in feet of center of cable at temperature of erection.

s = tension in pounds at the center of the cable at the temperature of erection.

L = one-half the length of the cable, in feet, at the temperature of erection under the supposition that there is no wind blowing and that the cable has no weight.

GENERAL SOLUTION.

When the temperature decreases by d deg. the half length L of the cable contracts by kdL ft. and the resulting length is

$$L\,(1 - kd)$$

The cable now being loaded with W lb. per foot, a tension of TA results—as the maximum allowable—with a consequent elongation of the length $L\,(1 - kd)$ of

$$\frac{TA}{MA}\,L\,(1 - kd) = \frac{TL}{M}\,(1 - kd)$$

since the elongation of any body of uniform cross-section A, length L and under tension t equals $\frac{tL}{MA}$, as long as the elastic limit is not exceeded.

Therefore, the total length of the cable at minimum temperature and fully loaded would be

$$L\,(1 - kd)\left(1 + \frac{T}{M}\right),$$

which must equal the geometric half-length of the cable, or

$$L\,(1 - kd)\left(1 + \frac{T}{M}\right) = y + 2/3\,\frac{x'^2}{y}$$

also, since very closely

$$x' = \frac{y^2W}{2AT}$$

$$L\,(1 - kd)\left(1 + \frac{T}{M}\right) = y + \frac{y^3W^2}{6A^2T^2}, \text{ or}$$

$$L = y\,\frac{1 + \frac{1}{6}\left(\frac{yW}{AT}\right)^2}{(1 - kd)\left(1 + \frac{T}{M}\right)} \qquad (1)$$

At the time of erection only the weight w of the cable is acting on the cable; the deflection x and tension s necessary to support this dead load bear the relation

$$x = \frac{y^2w}{2s}, \text{ or}$$

$$s = \frac{y^2w}{2x} \qquad (2)$$

Since L is the length of half the unstressed cable at the temperature of erection, the elongation of L under tension s is

$$\frac{sL}{MA} = \frac{y^2wL}{2AMx^2}$$

so that the total length of the half cable is

$$L\left(1 + \frac{y^2w}{2AMx^2}\right)$$

and as this must equal $y + 2/3\,\frac{x^2}{y}$, the following equation is obtained for x:

$$x^3 - 1.5\,y\,(L - y)\,x - 0.75\,\frac{y^2wL}{MA} = 0 \qquad (3)$$

From this equation x, the sag to be given the cable at erection can most readily be found sufficiently close by trial with the help of a table of cubes. After x has been determined the tension s will be found from equation (2).

EXAMPLE.

For the example under consideration the expression for x, the sag to be given to the cable during erection, is

$$x^3 - 1.5\,y\,(L-y)\,x - 0.75\,\frac{y^3wL}{MA} = 0, \text{ in which}$$

$$L = y\,\frac{1+\frac{1}{6}\left(\frac{yW}{AT}\right)^2}{(1-kd)\left(1+\frac{T}{M}\right)}$$

Substituting in the last equation the value as given for the problem, L is found to be 500.4469 ft., so that the equation for x will be

$$x^3 - 335.18\,x - 11{,}478 = \text{zero},$$

from which, by trial with the aid perhaps of a table of cubes, x is found to be 27.45 ft.

The tension s is now found from the equation $s = \frac{y^2w}{2x}$ to equal 490 lb.

Since for all practical purposes it is close enough to find the deflection to the third significant figure, $x = 27.5$ ft. could have been found almost immediately by inspection of the cubic equation. However, when greater accuracy is desired for academic reasons, one can determine x more closely by Newton's method of approximation.

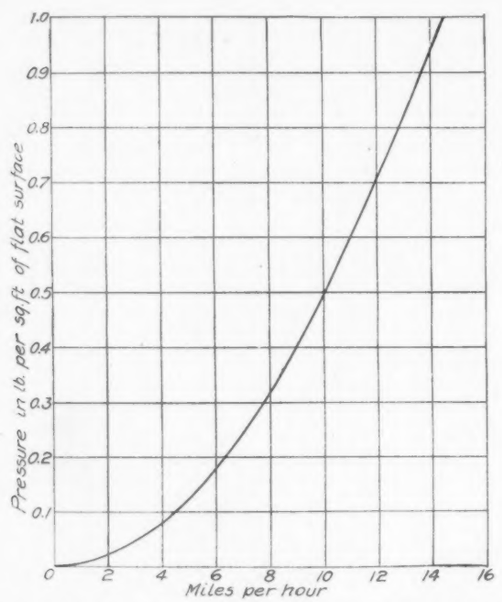


FIG. 2.—VARIATION IN WIND-PRESSURE WITH WIND VELOCITY.

Let $x^3 - ax - b = 0$ be the general form of the above cubic equation, then for any assumed value of v for x, the correction j is

$$j = -\frac{x^3 - ax - b}{3x^2 - a} = -\frac{v^3 - av - b}{3v^2 - a}$$

For $v = 27.5$.

$$j = -\frac{101}{1933} = -0.052,$$

and therefore a closer value for x is

$$x = 27.5 - 0.052 = 27.448 \text{ ft.}$$

The value of x may also be found directly from $x = 1.1547\sqrt{a}$ hypcos $\frac{\delta}{3}$, in which δ is determined from hypcos $\delta = 2.5981\,\frac{b}{\sqrt{a^3}}$, but it will be found that the method of approximation given above is the most rapid for determining the value of the sag.

REMARKS.

If any wind should be blowing at the time of erection it will be necessary merely to substitute in the equations in place of the weight w of the cable, the resultant pressure w' due to the weight acting vertically and the wind acting horizontally.

Fig. 2 shows wind-pressures as functions of wind velocities up to 16 miles per hour. The curve is based on Smeaton's formula

$$P = 0.005\,v^2,$$

in which P = pressure per square foot of flat surface in pounds, and v = velocity of wind in miles per hour. The formula is sufficiently close for small surfaces.

An ice coating will hardly be of cylindrical cross-section, but will rather tend to assume an elliptical or egg section, so that the wind-pressure per foot of cable would be larger than 13.8 lb. per square foot of projected *cylindrical* area would give. On the other hand, the chances of a combination occurring of maximum ice coating, very low temperatures and maximum wind-velocity are practically nil, and in case the cable should be strained a little beyond its elastic limit, it will elongate and thereby increase the sag and decrease the tension until equilibrium is established, even if this elongation should thus be made partially permanent.

The pressure p per square foot of projected cylindrical surface has, in accordance with the usual practice in this country, been assumed to be 50 per cent of the pressure P per square foot of flat surface, or

$$P/p = 0.50.$$

There exists, however, a considerable divergence of opinion among engineers and scientists in Europe as to the correct value of P/p. The following theoretical values are given for P/p: I. Newton, $P/p = 0.67$; Von Loessl, $P/p = 0.79$; F. Ritter, $P/p = 0.45$; and from experiments, D. Irminger, $P/p = 0.57$.

A Volt Scale for a Watts-Per-Candle Meter.

By Herbert E. Ives.

VOLT scales for indicating the voltage to produce a desired candle-power have been used on photometers in many incandescent lamp factories. They are better adapted to the requirements of the lamp trade than are candle-power reading scales, because the demand is not for a large range of candle-powers at one voltage, but for few candle-powers with considerable latitude in voltages. Recently the introduction of the graphitized and metallic-filament lamps has been marked by a new and more rational classification—namely, by watts per candle and total watts. To the writer's knowledge, however, there has not been developed a method of reading directly from the photometer the voltage to produce the desired watts per candle, and the watts corresponding to that voltage. Candle-power, current and voltage readings are made, none of which is necessarily the final value adopted, and sorting is done by rough calculation, aided by limit tables and by experience. It would obviously be advantageous to ascertain the voltage producing the correct watts per candle by direct reading, and, if possible, the corresponding watts or candle-power at the same time. The sorting of lamps would then be more quickly and probably more accurately done than by an indirect method. The specific consumption meter volt scale here described accomplishes this object.

A watts-per-candle or specific consumption meter, designed by Hyde and Brooks, is part of the photometric equipment of the Bureau of Standards.[1] It consists essentially of a wattmeter with a variable pressure circuit resistance, so arranged that as the photometer screen moves the wattmeter indicates the value of watts per candle. This instrument lends itself to the operation of finding the volts for a given specific consumption by the method of trial and error. Where the number of lamps is small and time is not too short, it affords a convenient and exact means of finding the voltage in question. In the extensive testing done by the Bureau for various government departments, under the Bureau's specifications, carbon lamps are run on life test at a uniform specific consumption of 3.1

[1] *Bulletin of the Bureau of Standards*, Vol. II, No. 2, page 145.

watts per mean horizontal candle. This fact necessitates determining for each lamp the voltage which produces this specific consumption. Finding the voltage by trial, with the consumption meter, proved too long an operation to be practicable with a large number of lamps, and a shorter procedure was sought.

Experiment showed it possible to calculate with considerable accuracy from the watts per candle at rated voltage—an initial run at rated voltage is part of the regular test—the voltage to give 3.1 watts per candle, by use of the relation $\left(\frac{V_2}{V_1}\right)^k = \frac{wpc_1}{wcp_2}$ where, for the range from 3.6 to 3.1 watts per candle, for treated carbon filaments, k has the value 3.5. The results of such a calculation may be used in the form of percentage tables, or the actual volt values may be calculated for each rated voltage encountered, and then tabulated. From such a table, for instance, it can be read that the e.m.f. of a 110-volt lamp operating at 3.5 watts per candle must be raised to 113.7 volts to operate at 3.1 watts per candle. Tables so calculated greatly reduce the work of finding the 3.1-watt voltage. It seemed desirable, however, to reduce further the number of operations, and this was accomplished by placing a scale in the consumption meter which indicates at once the data of the tables.

This scale is a volt scale, similar in idea to the volt scales used in assigning lamps to the 16-cp or 32-cp voltage, but differing in that it indicates the voltage that will produce a certain watts-per-candle. With a photometer operated at one e.m.f.—say, 110 volts—it is necessary merely to place on the consumption meter a new scale which shall read 110 at the 3.1 point—assuming 3.1 to be the watts-per-candle desired—111 at 3.21, 112 at 3.315, etc., in accordance with the voltage-watts-per-candle relation. The position of the photometer screen for the intensity match then shows on the new scale the 3.1-watt voltage.

In the Bureau of Standards work a complication arose from the fact that lamps must be photometered at the rated voltage, and the number of rated voltages is so large that separate scales for each cannot be conveniently placed on the instrument. Resort was had to an optical device to accomplish the same purpose. A series of volt scales for each value of volts from 80 to 130 were drawn, one above another, on a narrow strip of paper. Their 3.1 points being in a straight line, the volt marks when joined formed smooth curves, and the resultant complete scale consisted of a series of converging volt lines crossed at right angles by curved lines numbered to indicate the corresponding rated voltages. This scale was fastened on a small cylinder mounted to permit of rotation about a horizontal axis above the consumption meter scale. On top of the latter instrument was fastened a silvered glass mirror from whose lower surface the silver had been removed up to a line, whose curvature was approximately that of the instrument scale. This mirror, so placed that no parallax exists between the needle and the image of the outside scale, permits of reading the volts from any volt line which has been turned to a fixed pointer, by merely placing the eye in position to see the volt line at the edge of the silver mirror, and observing the needle past the edge. This operation is no more difficult than the usual sighting of a needle over its image, and as quick. Since there is no parallax, special pains need not be taken to have the eye exactly centered laterally—in fact, both eyes may be used. The instrument in this form has been used with complete success in the Bureau's testing of carbon lamps.

A possible application of the volt-scale consumption meter is in the rating and sorting of lamps according to the watts per candle, the quantity now recognized as of most importance. By having factory photometers operated at definite voltages, as is done with present volt-scale photometers, it is at once evident that volt-scale consumption meters would indicate at one reading the voltage at which lamps should be rated. A further requirement must be met before the lamp is completely rated—namely, the candle-power or watts at the voltage indicated should be specified; this can readily be done by an extension of the volt-scale idea. It is necessary, if candle-power indications are desired, merely to have scales on the photometer bench showing the candle-powers at various voltages corresponding to candle-powers at the voltage used. For instance, the 16-cp point for the 110-volt scale would be the 19.5-cp point on the 114-volt scale. These scales, whose similarly numbered points may be joined by continuous lines, may be conveniently mounted on a cylinder, as is done at present with different candle-power scales where sector disks are used. When a voltage is indicated by the consumption meter scale, the candle-power scale should be turned to the point corresponding to that voltage—a line on the cylinder, or a division on the turning mechanism. The candle-power at rated voltage is then shown by the pointer attached to the photometer screen.

If the value of the watts is desired, a similar watt-scale may be made whose readings are the candle-powers in the above scale multiplied by the common watts-per-candle. In this case the watt reading would, of course, be subject to the errors of photometric setting. An alternative form of watt-scale could be made by multiplying the actual specific consumption reading by the candle-power reading, by the use of scales, each corresponding to a certain specific consumption, mounted upon a cylinder as described above. In this way the candle-power reading is eliminated, and the value of watts at the photometer voltage may be read independently of errors of candle-power estimation. Instead of actual watts, watts at the voltage corresponding to the consumption meter indication may be plotted in a manner similar to that described for candle-powers.

It is therefore possible, by combining a volt-scale on a watts-per-candle meter with proper scales on the photometer, to read from one photometer setting: (1) Voltage to give a certain specific consumption; (2) candle-power or watts at that voltage. In short, the quantities now desired in rating incandescent lamps are ascertained at one operation.

It is of practical interest to know how accurately lamps may be placed at a desired watts-per-candle by the use of a volt-scale consumption meter. It is obvious that the placing depends upon the uniformity with which individual lamps conform to the voltage-watts-per-candle relation used in plotting the scale. Experiments with about 2000 lamps of several different makes have shown that those of any one make can be placed regularly within a range of from 3.05 watts to 3.15 watts per candle from readings made in the neighborhood of 3.50 watts per candle. With different makes the amount of "treatment" of the filament varies, thereby requiring a different voltage exponent. The change of exponent has been found to be accounted for by the changed voltage-candle-power exponent—that is, if the exponent in the equation $\left(\frac{V_2}{V_1}\right)^\kappa = \frac{cp_2}{cp_1}$ is 5.7 instead of 5.5, the exponent in the equation $\left(\frac{V_2}{V_1}\right)^\kappa = \frac{wpc_1}{wpc_2}$ is 3.7 instead of 3.5.[3] In other words, any shortcoming in the specific consumption-meter volt-scale plan is only such as would be met with in using a volt scale for candle-power work with the same lamps. In any one factory where the product is reasonably uniform, a watts-per-candle volt-scale should be quite as practical as the present volt-scale photometer.

Single-Phase Commutator Motors.

A mathematical paper on single-phase commutator motors, by Mr. M. O. Rethy, appears in *La Lumière Electrique* for Feb. 27 and March 6. He discusses the loss in the coils short-circuited by the brushes in single-phase series motors. This loss is calculated when the armature revolves and Mr. Rethy explains the fact which has been observed that the formation of sparks is not greatly influenced by the speed of the motor. Finally, in order to show the value of these losses a numerical example is given. It is demonstrated that these losses decrease very rapidly when the motor begins to run up in speed. In the example this loss at synchronism is only one-third of the value for the armature at rest.

[3] See article by F. E. Cady, Illuminating Engineering Society Convention, October, 1908.

Even Harmonics in Alternating-Current Circuits.

By Charles P. Steinmetz.

In general, even harmonics of the voltage and current waves cannot exist in alternating-current circuits; therefore, in investigating the possibility of the high voltage produced by resonance with some over-tones of the generator wave, only the odd harmonics are usually considered.

Without commutation, rectification or similar phenomena, the voltages generated by electrodynamic induction in revolving machinery, or by transformer action, and also the currents produced by these voltages, probably always have both half-waves of identically the same shape. When both half-waves have the same shape, the wave comprises only odd harmonics, since an even harmonic produces a difference in the shape of the positive and the negative half-wave. In any of the existing revolving electrodynamic machines, regardless of the distribution of the magnetic flux and the arrangement of the conductors, a rotation by 180 electrical degrees brings the induced conductor back into the same relative position with the inducing magnetism, but with reversed direction, and hence the voltage wave repeats the same values in opposite direction; that is, the second half-wave has the same shape, but the opposite direction of the first half-wave, so that even harmonics are absent.

However, even harmonics may occur in the transient waves of electric circuits. Thus the free oscillation of a transmission line which is induced by a lightning discharge in general contains numerous higher harmonics, even ones as well as odd ones, in addition to the fundamental wave.

Even harmonics of current and even harmonics of voltage frequently occur in the transient terms of current and voltage resulting from sudden changes of circuit conditions; they may reach very high values, as in the momentary short-circuit currents of alternators, in the starting currents of stationary transformers, etc. Therefore, it is not safe to assume that no even multiple of the generator frequency could exist in alternating-current circuits; while such even harmonics cannot persist continuously, they may appear momentarily and for a short time and may reach high values.

The above facts may be illustrated in the starting current of a stationary transformer. When connecting a transformer to an alternating-current circuit, a transient term of current appears, because the permanent values of the magnetism of the transformer does not correspond to the instantaneous value of the impressed e.m.f. at the moment of closing the circuit. The momentary or starting current may reach very high values. The calculation of this transformer starting current I have discussed on page 188 of "Transient Electric Phenomena and Oscillations." Taking the numerical values of the exciting current for the first complete wave, from 0 deg. to 360 deg., from the table on page 188, and resolving into a Fourier series, gives the approximate equations for the first wave of the exciting current:

$$
\begin{aligned}
e &= E \sin \Theta \\
i &= 108.3 \\
&- 183.8 \cos\ (\Theta + 28.0 \text{ deg.}) \\
&+ 112.4 \cos 2 (\Theta + 29.8 \text{ deg.}) \\
&- 53.1 \cos 3 (\Theta + 33.3 \text{ deg.}) \\
&+ 27.2 \cos 4 (\Theta + 39.1 \text{ deg.}) \\
&- 18.4 \cos 5 (\Theta + 38.1 \text{ deg.}) \\
&+ 13.6 \cos 6 (\Theta + 33.4 \text{ deg.}) \\
&- 8.1 \cos 7 (\Theta + 32.7 \text{ deg.})
\end{aligned}
$$

where the circuit is assumed as closed at the moment: $\Theta = 0$; that is, at the zero point of the half-wave.

Or, substituting:

$$\Theta = \Psi + 150 \text{ deg.}$$

that is, assuming the circuit as closed at the zero point: $\Psi = 150$ deg. of the half-wave, gives:

$$
\begin{aligned}
e &= E \sin (\Psi + 150 \text{ deg.}) \\
i &= 108.3 \\
&+ 183.8 \cos\ (\Psi - 2.0 \text{ deg.}) \\
&+ 112.4 \cos 2 (\Psi - 0.2 \text{ deg.}) \\
&+ 53.1 \cos 3 (\Psi + 3.3 \text{ deg.}) \\
&+ 27.2 \cos 4 (\Psi + 9.1 \text{ deg.}) \\
&+ 18.4 \cos 5 (\Psi + 8.1 \text{ deg.}) \\
&+ 13.6 \cos 6 (\Psi + 3.4 \text{ deg.}) \\
&+ 8.1 \cos 7 (\Psi + 2.7 \text{ deg.})
\end{aligned}
$$

The permanent value of the exciting current of this transformer, as it exists a considerable number of cycles after the start, is given on page 589 of "Alternating-Current Phenomena" (fourth edition), and is expressed by the equation:

$$
\begin{aligned}
i &= 3.98 \cos\ (\Theta + 37.6 \text{ deg.}) \\
&+ 0.85 \cos 3 (\Theta + 4.1 \text{ deg.}) \\
&+ 0.25 \cos 5 (\Theta - 1.7 \text{ deg.}) \\
&+ 0.14 \cos 7 (\Theta - 3.2 \text{ deg.}) \\
&+ 0.07 \cos 9 (\Theta - 2.5 \text{ deg.})
\end{aligned}
$$

and has the effective value:

$$I = 2.89$$

As seen, the permanent exciting current contains no even harmonics, but the momentary exciting current contains a constant term and very high, even harmonics. The second harmonic, having a maximum value of 112.4 amp, almost reaches the same magnitude as the fundamental wave, which has a maximum of 183.8.

In the first wave of the starting current the effective value of the current is 176.3; the constant term is 108.3: The effective value of all of the odd harmonics together is 135.8, and the effective value of all of the even harmonics together is 82.3.

That is, the effective value of the even harmonics reaches nearly 50 per cent of the effective value of the total current; that is, it is of the magnitude of the full-load transformer current.

It is interesting to note that in the permanent, as well as the momentary, exciting current of the transformer all harmonics are approximately in phase; that is, they add their maximum values, and hence the wave is peaked.

Snow Loads on Transmission Lines.

By Max H. Collbohm.

There are three factors entering into the mechanical design of a transmission line, namely, weight of conductor, weight of

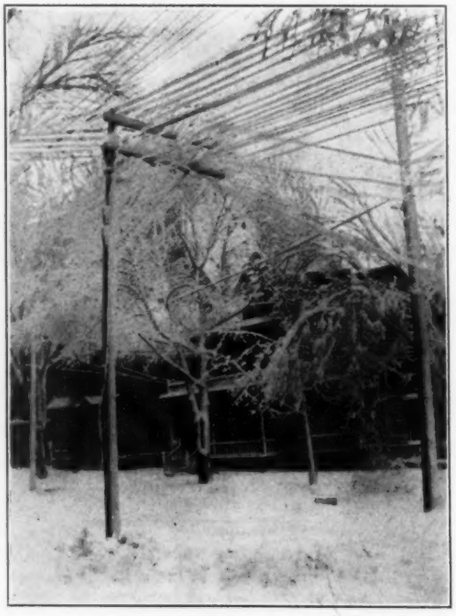


FIG. 1.—SNOW-CLAD LINE WIRES.

sleet and snow around the conductor, and wind-pressure acting upon the increased diameter of same. The size of wire and its weight are obtained from the commercial and electrical calcula-

tions and represent certain fixed value. The other two factors, however, are variable and their possible value must be assumed with reference to the particular climatic conditions. These assumptions for the same climatic conditions vary widely with different engineers, and because the transmission line represents a considerable item in the total cost of the power development, and as therefore any saving in the height of the poles and their

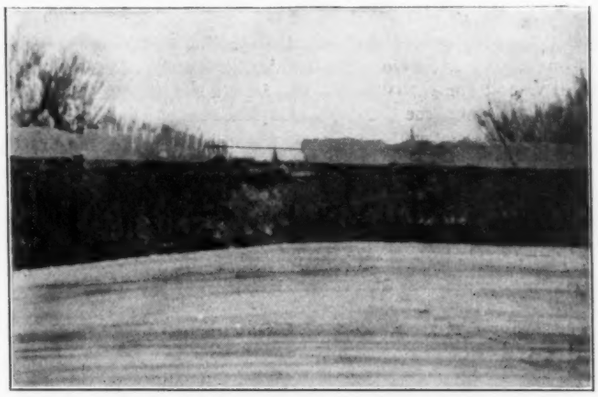


FIG. 2.—SNOW-CLAD WIRE.

number will reduce the cost very materially, there is a great temptation to assume so low a figure for snow and wind loads as actually to stress the line beyond its elastic limit under certain severe conditions which, as experience shows, are not so very remote as is generally believed.

As a rule, the amount of snow actually assumed for transmission lines is from ½ in. to ¾ in. all around the conductor, or about 2 in. maximum outside diameter for a heavy trans-

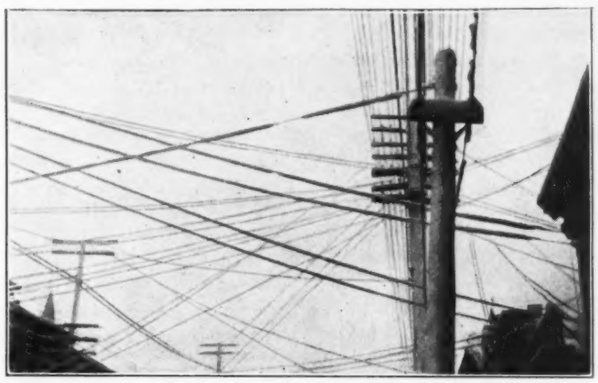


FIG. 3.—SNOW-CLAD LINE WIRES.

mission cable. It is furthermore generally assumed that a considerable sleet and snow coating can form only at a temperature of about 30 deg. Fahr., at which the line sag would not be reduced to its minimum value. Moreover, there is no wind taken into account on the assumption that a strong wind would not allow of sleet formation on the wires.

However, the conditions experienced during this winter in Wisconsin and the neighboring States prove these assumptions to be far too low for any similar climatic conditions. The snow storm of Jan. 28 covered practically all the overhead wires of the affected region with a coating of sleet and snow to a diameter of from 2½ in. to 4 in. The temperature went down to 4 deg. Fahr. below zero, while the wind velocity was recorded as 40 miles per hour. This shows that snow will form around the wires even with a strong wind, and that the temperature may go down quite low with the snow and wind pressure still on the wires. The accompanying photographs will serve to illustrate the conditions just mentioned. Tests made on a number of broken wires showed a good average of about ½ lb. of sleet and snow per foot of wire, the maximum being a little higher. These samples were taken from wires of small size, about No. 10, but the larger wires did not show any appreciable difference in the amount of sleet and snow on them. As none of the larger cables was readily available for testing, clothes-lines of a size similar to No. 0 were taken instead, which showed also the same average snow load as the smaller wires, or ½ lb. per foot.

Although all these data were not obtained from a real high-

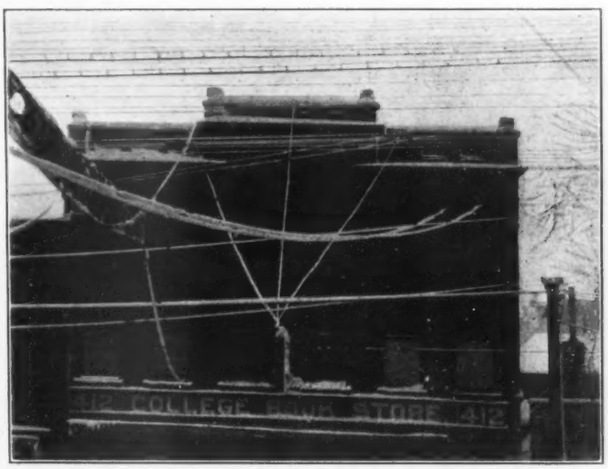


FIG. 4.—SNOW-CLAD LINE WIRES.

tension transmission line, they will be equally valuable in the design of such lines. For although it is believed that high-tension wires will not allow of sleet and snow formation around them, it is nevertheless true for the grounded guard wire and for transmission lines of 11,000 volts and less, for which sleet formation has been recorded. Considering that the guard wire should be of low ohmic and inductive resistance in order to be effective—that is, either of copper, aluminum or eventually copper-clad steel wire; furthermore, that its cross-section will never be larger than that of the wires it has to protect, and finally, that its location highest above ground will expose it to the greatest wind pressure—it is obvious that full provision must be made to meet the severest conditions which are likely to arise, and the more so as, contrary to any other mechanical structure, the transmission wires are figured with hardly any factor of safety for the greatest assumed stress.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Modern Salesmanship.

Mr. George Landis Wilson, of F. Cortez Wilson & Company, delivered the address after the weekly luncheon of the Electric Club of Chicago on March 17. His subject was "Costs and Selling," and he gave an instructive talk on the dignity of salesmanship. One of his points was that any salesman worthy of the name should be given the actual costs of the products that he offers for sale. Mr. Wilson said that the value of any salesman could be determined by computing the value of what he brings in minus the cost of the supervision necessary to keep him going. He pointed out that service commands better prices than goods, and that the customer must be taught how to use the things he buys. The salesman should be consulted about the design and making of the things sold. Further, it must not be forgotten that both parties to the transaction of buying and selling must make money by it if business relations are to be permanent.

Electric Automobiles at Hartford.

Upward of 100 electric automobiles for pleasure service are in regular use in Hartford, Conn., the charging current being supplied by the Hartford Electric Light Company. On the company's circuits are 45 charging points in individual private stables or residential garages. These automobiles are largely used by ladies, and in many cases the owners do their own charging through mercury-arc rectifier outfits, the rate for energy being 4 cents per kw-hour. There are about a dozen commercial garages in Hartford, all equipped with charging facilities. The facilities for charging in the surrounding country are also good. Several commercial trucks are in service, including hotel vehicles, which can be charged while waiting between trips.

Chicago Conference on Electric Vehicles.

One indication of the renewed interest in electric vehicles on the part of manufacturers and central-station men is the announcement of an "Exide smoker," to be held in the rooms of the Western Society of Engineers, Chicago, on the evening of March 31. The meeting will be held under the auspices of the Electric Storage Battery Company, and Mr. Godfrey H. Atkin, manager of the Chicago office of that company, will preside. Mr. Bruce Ford, of Philadelphia, designing engineer for the company, will present a paper on "The Exide Battery—Its Care and Operation," illustrated by lantern slides. Following this there will be a paper on "The Relation of Central Stations to the Automobile Business," by Mr. E. W. Lloyd, general contract agent for the Commonwealth Edison Company, of Chicago. Several hundred invitations have been issued to this meeting, and all present are invited to join in a general discussion of this important subject. There are said to be about 3000 electric automobiles in Chicago alone, so it can be readily seen that the business is one of considerable importance. The electric vehicle has undoubtedly grown in popularity throughout the country, and companies furnishing electric power appreciate in an increasing degree the importance of this demand for their product, not only by reason of the actual current consumption, but by the improvement of the load factor.

In the case of the Chicago conference, the invitations have been sent to electric vehicle manufacturers, battery distributors, central-station men and superintendents of garages, and it is believed that an important and interesting conference will be the result. This is the first time that a conference of this character has been held in the West, although similar gatherings have been held in Boston and San Francisco.

Reduction in Rental Charge for Tungsten Clusters in Chicago.

The Commonwealth Edison Company, Chicago, has made a reduction in the rental charge for tungsten clusters put out on a meter basis. Hereafter the rental charge for a cluster consisting of four 60-watt tungsten lamps (including renewals) will be $1 a month where the cluster is used 90 hours or less in the month, with an additional rental charge of 6 cents a month per cluster for each additional 15 hours' use (or fraction) above the 90 hours. This is a reduction from $1.25 to 7½ cents, respectively. In addition to the rental charge, there is a meter charge for electricity used by the cluster. No change has been made in the meter rate, but it may be of interest to quote the exact language of the contract in relation to it:

"In addition to said rental charge, the consumer agrees to pay the company for electricity consumed, 13 cents per kw-hour for the consumption in each month up to and including an amount that would be equal to 30 hours' use of the consumer's maximum demand in such month, and 8 cents per kw-hour for the consumption in such month in excess of that amount, provided, that an abatement or reduction of one-half cent per kw-hour will be allowed the consumer for all the electricity consumed in each month hereunder, and provided further, that whenever any monthly bill shall be paid at the proper office or agency of the company within 10 days after its date, the consumer shall be entitled to a discount from such bill equal to one cent per kw-hour of the total consumption charged for therein. The electricity consumed shall be measured by a meter or meters to be owned and installed by the company. The maximum demand shall be ascertained by a maximum recording meter or meters, likewise owned and installed by the company, unless only one cluster is furnished hereunder, in which case the maximum demand for each month shall be taken to be 240 watts."

Maximum-Demand Rates at Aurora, Ill.

The Western United Gas & Electric Company, of Aurora, Ill., employs a system of readiness-to-serve or maximum-demand power rates which was worked out several years ago by Mr. H. L. Rice, manager. It is an unusual combination of the readiness-to-serve or Doherty rate, with a discount according to load factor.

This rate is made up of a maximum-demand or readiness-to-serve charge, and a kw-hour charge. No bill is rendered for less than $3, which constitutes the minimum monthly charge for power service. The maximum-demand or readiness-to-serve charge is a flat rate of $1 per horse-power of maximum demand or fraction thereof per month. The maximum demand or peak load of the consumer is determined from time to time as the company may see fit, or as the consumer may request. The kw-hour part of the rate is 4 cents, with the following discounts for different classes of consumers:

Class A.—Where the bill at 4 cents per kw-hour does not equal twice the maximum demand, there is no discount. *Class B.*—Where the bill at 4 cents per kw-hour is twice the maximum-demand charge or more, the discount is 0.5 cent per kw-hour. *Class C.*—Where the bill at 4 cents per kw-hour is four times the maximum demand, the discount is 1 cent per kw-hour. *Class D.*—Where the bill at 4 cents per kw-hour is six times the maximum-demand charge, the discount is 1.5 cents per kw-hour.

It will be seen from a study of these rates that the readiness-to-serve or maximum-demand charge is designed to pay the fixed operating and investment costs, which are proportionate to a consumer's maximum demand. The kw-hour charge is intended to cover the cost of operation. These costs being higher for a consumer with a good load factor using energy many hours per day than for a consumer with a poor load factor, the discount given on the kw-hour rate is made dependent on the ratio of the kw-hours to the maximum demand; or, in other words, is dependent upon the load factor.

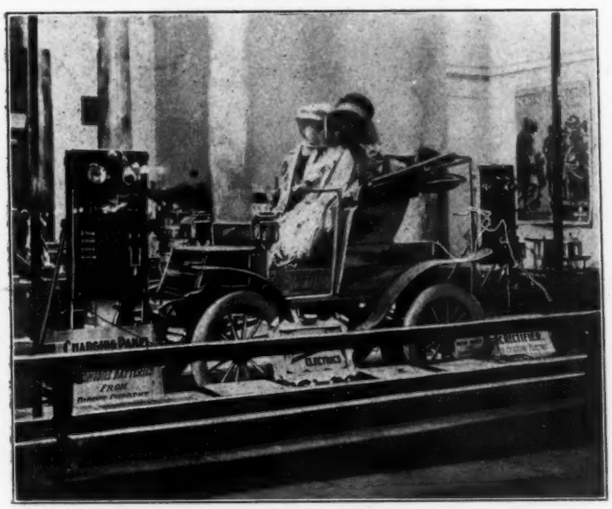
One good point about this system, which recommends it to every central-station man who has to explain rates to the public, is that it is one which is comparatively easy to understand. It does not involve the use of the term "load factor" or any expression which cannot easily be explained to a consumer.

Boston Electric Vehicle Campaign.

The energetic manner in which the Boston Edison Company is co-operating in extending the electric vehicle business is indicated by the recent assignment of one of its staff, Mr. A. C. Gray, as special agent to devote his entire time to working among garage managers, automobile manufacturers and manufacturers' agents throughout the Boston territory. He will visit all of the garages, giving the managers and their employees such information as they need about charging outfits and the maintenance of electric vehicles. He will also inform them as to the cost for charging and give them all the information he can about the Edison company's facilities. It will be a part of Mr. Gray's work to see that present users of electric machines of all sorts know everything there is to know about the availability of charging stations, and he will also see that they are informed as to the feasibility of installing their own rectifiers

and other apparatus. Much enthusiasm and real interest are developing in Boston and throughout New England over the possibilities of the electric vehicle.

The Edison Electric Illuminating Company, of Boston, has recently placed on exhibit in the display windows of its main building, on Boylston Street, an electric automobile, with charging outfit and data bearing upon the cost of operation. The machine is a model "22 C" Studebaker electric stanhope phaeton, equipped with a 24-cell Exide battery. It is built with a 53-in. gage, 67-in. wheel base, 30-in. wheel diameter, and has foot lever brakes on the rear axle and armature shaft. The vehicle has clincher pneumatic tires, a single motor, voltammeter, side and tail lamps, tools and leather top, with mudguards and cushions. Attached to the seat are two wax lay figures in full automobile costume, representing ladies enjoying



WINDOW ELECTRIC AUTOMOBILE DISPLAY IN BOSTON.

a spin in the machine, and a realistic touch is given by an adjacent 12-in. fan motor which blows the veils and artificial tresses about in true sporting style.

Attached to the machine is a printed card giving the following data upon operating cost:

SIX MONTHS' RECORD.

Operation—	
Total number of miles	3,437
Total number of charges	91
Average miles per charge	37.77

OPERATING EXPENSE.

Cost of current for charging battery (rate 7 cents per kw-hour)	$51.16
Average cost per charge	0.6019
Average cost per mile	0.0166

MAINTENANCE.

Repairs (mechanical)	$10.15
Battery	6.00
Tires	62.00
Painting	21.40
Total gross operation and maintenance	130.72
Average gross expense per day	0.7182
Average gross expense per mile	0.038

At one side of the machine are shown a standard General Electric charging panel and mercury arc rectifier set, with the usual instruments, circuit breakers, switches, fuses and rheostat equipment. An Exide battery, motor-driven tire pump and a Morse vapor-proof hand lamp are also shown. The exhibit has attracted widespread attention.

Central-Station Service at Albany, N. Y.

By WILLIAM H. STUART.

Albany, the capital of New York, and also the county seat of Albany County, has a population of about 100,000 inhabitants. Its electricity is furnished by the Albany Electric Illuminating Company, which has given an uninterrupted service for a quarter of a century.

The equipment of the plant consists of seven 550-hp, hand-fired Stirling boilers, two 1200-hp Knowlson & Kelly engines, one 1000-hp Allis engine, one 400-hp Greene engine and two 300-hp Harris engines. The electrical equipment comprises two 800-kw, 2300-volt Westinghouse alternators; one 300-kw, 2300-volt Westinghouse alternator; one 250-kw, 500-volt generator; two 200-kw, 500-volt generators; one General Electric machine and the other Walker, and nine 125-light Brush arc dynamos.

At present the company is purchasing considerable energy from the Hudson River Electric Power Company. About 8000 hp at 11,200 volts is delivered over two paper-insulated cables coming underground from North Albany. The steam-generating equipment is held in reserve and is brought into operation when the water-power fails. On a jack-shaft are two 550-kw synchronous motors which normally operate the arc machines. A Westinghouse 50-kw motor generator is used as an exciter. Off the main building a brick addition has been erected as a transformer station. Here are placed two sets of transformers. These are of the General Electric, hand-regulated, oil-insulated and water-cooled type rated at 40 cycles, 2000 kw. They step down from 11,200 volts, three-phase, to 2300 volts, two-phase, for the incandescent service. The motor load is fed from three 250-kw transformers.

The main switchboard is placed on a gallery and is made up of 11 panels. The high-tension panels have remote-control, hand-operated oil switches, and the busbar connections are in soapstone cells. On a separate board of 14 panels there are two panels for the three-phase, 2300-220-440-volt alternating-current motor service; two panels of white marble for the 2400-volt, two-phase incandescent service; two panels of black slate for the 500-volt rotary set; three panels for the 500-volt generators, and five feeder panels. The arc switchboard controls 14 circuits.

No. 1 buckwheat coal is used in the steam plants and is stored in a pile of about 1000 tons in a yard adjoining the station. From the coal pile a trolley is used to bring the coal to the boilers. The ashes are carted to the yard and building contractors take it away, using it for cinder concrete.

The lines are all overhead and the transformers used on the poles are rated at 25 kw and 50 kw. They are grouped where the business necessitates.

The company operates 850 Brush arc lamps at $98.50 per lamp per year. There are 70,000 16-cp lamps connected, and the motor load is about 4500 hp, of which 2500 hp is on the 500-volt service and the balance on the three-phase service. The largest single motor on the company's lines is rated at 125 hp and drives a 90-kw generator in the plant of the J. B. Lyons Company, where all the printing for the State is done. Electricity in this establishment, which was formerly supplied by an isolated plant, is brought into play wherever possible. All sorts of heating apparatus, glue-pots, presses, etc., are operated by it, besides 3200 16-cp lamps and several electric elevators.

The meter department is operated by three men, a chief and two assistants. When the meters are received they are tested and given a number. Along with this they are marked by numerals which designate the voltage, amperage and type of meter, two- or three-wire, and whether of the commutator or induction type. The meters are tested on the premises on receipt of complaint of high bills, etc. Once a year the meters undergo regular test and examination. The monthly readings are taken by the meter-department men. Most of the meters are of Westinghouse make.

The company maintains no showrooms or complaint department. The matter of display is left entirely to the contractors, and the company by its service and careful supervision of its officials has made a complaint department a thing of the past. The new-business work of the company has been in operation for almost five years. During the last three years the business has been tripled. The company employs one solicitor and at one time had an advertising campaign of follow-up letters, circulars, pamphlets, etc., but the results were not satisfactory and it was abandoned. The company is in active competition with the gas company, and it was found that to carry on the fight successfully, friendly relation with the contractors was neces-

sary. This was accomplished by having all construction work, the sale of lamps, fixtures, motors, etc., done by the contractors. The latter have prominently situated shops and stores, and employ solicitors to go after business. They advertise constantly and, in fact, do all the work of an up-to-date new-business department. A great amount of business has been brought to the company by this method. The company has been very liberal in all matters with the contractors and has helped them in every way possible. In four years 78 isolated plants have been supplanted by central-station service. The company advertises in the newspapers as a matter of policy, and on the backs of the bills are placed reminders, according to the season, of fans, heating and cooking appliances, etc.

The sign and window-lighting business nets the company many thousands a year. This business is on a flat rate and the lighting circuits are under the control of the company. The signs are furnished free under a two-year contract. The rate for a panel sign containing 24 4-cp lamps is $7.50 per month. The sign is lighted from dusk until 11 p. m. every night, when the lamps are switched out of circuit by one of the company's men. There are over 300 signs in use. Energy for lamps and heating devices ranges from 10 cents to 3 cents and for motors from 5 cents to 2 cents, according to the consumption.

Mr. A. A. Anderson, the general manager of the company, in speaking of the new-business methods and work in Albany, said that "from the very outset it was determined to do everything possible to give and maintain as perfect a service as possible, in the belief that this would be a potent factor. The service complaints are few and far between and when received are attended to with dispatch. That perfect service has fully justified itself is very apparent. There were in Albany a great many isolated plants and to-day all but one or two are discarded. By inducing contractors to get out and hustle for business we have secured very good outside aid in our work. It was at first rather slow getting contractors to co-operate along the lines that we planned, but it was not long before matters began to shape themselves, and to-day we have one of the best and most effective sets of contracting firms to be found anywhere. We help them in every way possible and do nothing in their line at all. Our increase in new business has been steady, and we owe it to our service and the good work of the contractors."

The personnel of the company is as follows: President, Mr. A. N. Brady; vice-president, Mr. R. C. Pruyn; secretary and treasurer, Mr. E. P. Gavit; general manager, Mr. A. A. Anderson; superintendent, Mr. T. Powers; chief engineer, Mr. J. D. Dennin.

INTERIOR WIRING AND ILLUMINATION

Montgomery (Ala.) City Sign.

Much interest was developed in Montgomery, Ala., in connection with a recent competition for a legend for a large sign to be erected in full view of railroad lines and having for its purpose to call attention to Montgomery as a hustling city. Numerous suggestions were received, and a committee of citizens having charge of the contest finally adopted one of two lines, "Montgomery—Your Opportunity," with the design of a key between, which will be flashed out at intervals. The letters will be 10 ft. high. The sign will be erected and maintained by the Montgomery Light & Power Company without expense to the city.

Decorative Illumination in Vienna.

The Vienna Municipal Tramways took an active part in the jubilee which was held in Vienna last December to celebrate the sixtieth anniversary of the accession to the throne of Emperor Francis Joseph I. Through the courtesy of Mr. L. Spangler, manager of the Vienna tramways system, a view is given herewith of the illuminated train of cars which traversed the lines of the company on the evening of Dec. 1 and also an exterior view of the office building of the company, showing the artistic arrangements of lamps. The train of cars was made

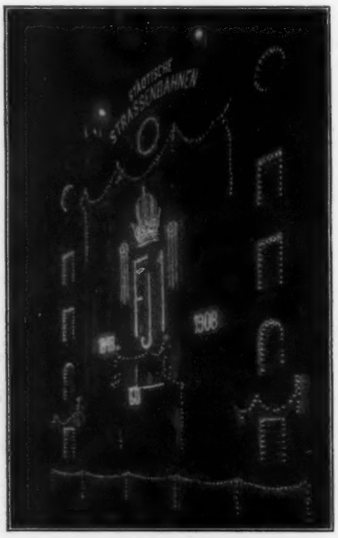


FIG. 1.—DECORATIVE LIGHTING OF OFFICE IN VIENNA.

up of two motor cars, one at each end, and a trail car between them. Each motor car was equipped with 575 10-cp lamps arranged in circuits of five lamps each and the trail car was equipped with 750 lamps of the same size. To supply the addi-

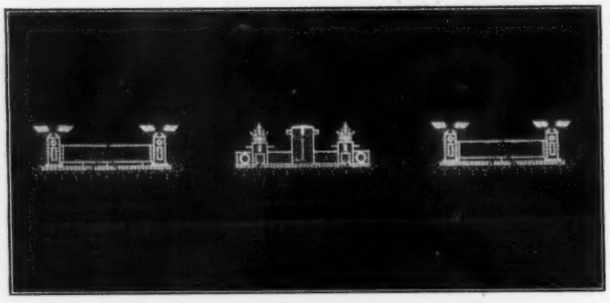


FIG. 2.—DECORATIVE LIGHTING OF A THREE-CAR TRAIN.

tional power required for these lamps while running on the overhead system, a trailing contact was used. On the conduit section of the line and auxiliary collector was also employed. The car house light was effected by lamps of the same size.

Tests of Indirect Illumination.

At the meeting of the Chicago section of the Illuminating Engineering Society, March 11, Mr. J. R. Cravath presented a paper entitled "Some Notes and Tests of Indirect Illumination." This paper gave results of tests carried on under the supervision of the author by Profs. J. E. Snow and E. H. Freeman, of Armour Institute of Technology, in two rooms of a residence, employing a system of indirect lighting, using a central chandelier equipped with an inverted, silvered, corrugated concentrating mirror reflector pointed upward. This is the combination now being marketed under the name "I-Comfort System." The tests were made using a tungsten lamp and measurements were taken 32 in. from the floor at regular intervals over the entire area of each room, so as to obtain the average illumination.

In one room with light ceiling and dark-green walls and rug, which was about 15 ft. square and 9 ft. 9 in. high, the watts per square foot required to produce 1 foot-candle average illumi-

nation (that is, the watts per lumen) were found to be 0.45. In another room, about 13 ft. square, with light-colored walls, the watts per lumen were found to be 0.35. A 100-watt tungsten lamp was employed in both these tests and all results were corrected to the rated candle-power and the wattage of the lamp. In the room with the dark walls 15 ft. square, the illumination varied from 1.9 foot-candles in the middle to 0.5 foot-candle in the corners. In the room with light walls, 13 ft. square, the illumination varied from 2.5 foot-candles in the middle to 1.2 foot-candles in the corner. The author compared the efficiency obtained in these tests with the tests made by Messrs. Lansingh and Rolph in a room 24 ft. x 11 ft., 10 ft. high, reported to the Illuminating Engineering Society convention, October, 1908. These latter tests were selected as being nearest to the conditions of the rooms tested by the author, although he uttered a word of caution as to accepting without reserve comparisons of this kind made in different rooms by different observers with different instruments. Lansingh and Rolph obtained 0.43 watt per lumen with a bare tungsten lamp at the ceiling in a room with dark walls and light ceiling, as against 0.45 obtained in a similar room with indirect lighting in the present tests. They also obtained 0.3 watt per lumen using the tungsten lamp with a bowl-type prismatic reflector, as it would most commonly be used. This would indicate that the indirect system under the conditions of this test caused a loss of about 33 per cent, as compared with the most efficient direct system employing a tungsten lamp with reflector. If no reflector were employed, but a diffusing globe absorbing 20 per cent, placed over the tungsten lamp, Lansingh and Rolph would probably have obtained 0.54 watt per lumen as against 0.45 with the lamp completely concealed, using the indirect system in the present test. In the room with light walls Lansingh and Rolph obtained a value of 0.23 watt per lumen using a bowl-type prismatic reflector with the lamp at the middle of the ceiling, as against 0.35 obtained in the present test with indirect lighting.

Commenting on the system of indirect lighting from central chandeliers in general, the author pointed out that when most of the light is first directed to the central part of the ceiling by a concentrating reflector, the illumination is very much like that obtained through a dense skylight. The shadows are about like those produced by diffused daylight coming through a skylight. He pointed out that there is considerable difference between indirect lighting of this kind, where most of the light is obtained by reflection from certain areas on the ceiling and the kind of indirect lighting which has frequently been adversely discussed in the *Transactions* of the Illuminating Engineering Society, where the walls were so very highly illuminated as to be annoying. In many cases where maximum economy is desired, a combination of direct and indirect lighting is best.

In office work the glare from highly sized papers is one of the most objectionable features of direct lighting, so that if there is a sufficiency of indirect lighting the results will be more comfortable than where there is a combination of the two. In conclusion he called attention to a mistake that is likely to be made in the use of indirect lighting from chandeliers; namely, that of not hanging the lamps and reflectors high enough. The higher the unit is hung, the greater the concentration of light beneath the fixture. If the fixture is hung low there is excessive waste of light on the walls, if the walls are dark and the room is high and narrow. Dirt always has been and always will be the greatest enemy of this type of equipment, especially in the downtown districts of large cities. Here the users must fully understand the importance of frequent cleaning and accept it as a part of the price of comfortable lighting.

In the discussion reference was made to the trial of the indirect chandelier method at a recent meeting of the Philadelphia section. The room was 26 ft. high and the lamps were hung low. The resultant inefficiency was only what might be expected for such conditions.

It was brought out that the system of indirect lighting from chandeliers has been tried many times in the past. That it has never before received the attention that is now being given to it in Chicago and vicinity is probably due to the inefficient lamps, inefficient reflectors and inefficient cleaning employed in the past. The tungsten lamp and a better knowledge of reflecting surfaces and illuminating engineering principles have brought about changed conditions.

Mr. Beebe reported that 100 bookkeepers had been working under this system in the gas offices in Chicago several months with satisfaction as regarded illumination. The ventilation of the reflector for the gas-mantle burner had given some trouble, but was being improved.

Mr. George H. Jones reported having used this system combined with a handsome table lamp in his living-room for some months. The effect was favorably commented on by many visitors. He preferred to use it with dark walls rather than with light-colored walls.

Mr. W. P. Clawsen reported several months' experience with the system in his home and spoke especially of the comfort obtained. Mr. A. D. Curtis said that several thousand inverted reflector units had been put in service the past five months.

The Intrinsic Brightness of Lighting Sources.

There is hardly any photometric quantity which has given rise to greater discussion and difference of opinion than that of "intrinsic brightness." Although it has been differently defined by different writers, it has been generally accepted as the ratio of luminous intensity of a bright surface, measured along the normal, to the area of that surface. This is the same kind of quantity as an illumination, except that an illumination is a quantity received by a surface, whereas an intrinsic brightness is a quantity emitted by a surface. An intrinsic brightness is thus essentially a sort of negative illumination. For this reason, an intrinsic brightness admits of being expressed in foot-candles, or in meter-hefners. It is usually expressed, however, in candles per square inch, or in hefners per square centimeter. For instance, if a luminous point-source of 1 cp—that is, one spherical candle—were supported at the center of a perfectly diffusing opal glass globe 1 ft. in radius, the illumination cast upon all parts of the interior wall of the globe would be 1 foot-candle. If there were no absorption of light in the opal glass of the globe, it is evident that the intrinsic brightness of the globe, as viewed from any point outside the globe, might be expressed as 1 foot-candle. But the globe would have an external surface area, neglecting wall thickness, of 4π sq. ft., or 1809 sq. in.; so that we might also conveniently describe the intrinsic brightness of the globe, still assuming no absorption in the glass, as 1/1809 candle per square inch.

It is a very remarkable fact that if we set up a camera facing a bright body, such as the sun or an enclosed arc lamp, the focused image of this bright body on the receiving plate of the camera will have the same brightness at all distances, assuming the same diaphragm and no absorption of light in the atmosphere by fog or smoke. That is, as we take the camera further back from the bright body, the focused image of the body becomes smaller, but the brightness of the image, or flux of incident light per unit of area in the image, remains constant. The sun's image would be as bright in a camera at the position of the planet Jupiter as in the same camera at the position of the earth, when the earth and Jupiter are in line, but the image of the sun would be larger when photographed at the earth than when photographed at Jupiter, always neglecting the absorption of light in transit, and assuming the same iris diaphragm. If we apply this proposition to the camera of the human eye as a particular case, the brightness of the image focused on the receiving plate, or retina, is the same at all distances from a luminous source, if the iris diaphragm is the same—that is, if the pupil of the eye retains the same diameter and area. If we stand close to an enclosed arc lamp, the image of the brilliantly lighted globe will cover a relatively large surface on the retina. When we move back from the arc lamp to a distance of, say, a couple of hundred feet, the image of the arc globe as focused on the retina will be much smaller, and

cover a much smaller area of the retina, but the image will be equally bright in the two cases, or the ratio of total light stimulus to area of retina exposed to the stimulus will be the same if the iris diaphragm aperture is the same. Consequently, for a given iris diaphragm opening, we do not diminish the intensity of the stimulus on the retina produced by a luminous source when we carry the source away from the eye. The stimulus on each particular visual unit, or rod and cone in the retina, remains sensibly unchanged. We only alter the area of the stimulus, or the number of rods and cones that are affected.

The physiological laws affecting the working of the camera in the eye has not yet been analyzed with sufficient precision to warrant a positive statement; but it seems likely that the eye automatically tries to protect the retina against excessive local stimulus at any point. It is reasonable to suppose that if the local intensity of stimulus on any individual unit of the nervous mechanism in the retina is excessive, there is danger of injury to that particular unit, no matter how small the stimulus may be on any or all of the other units. Consequently, it is reasonable to suppose that the iris will be automatically constricted until the brightest object in the entire field of vision produces a local brightness of image, or local intensity of stimulus below the danger point. This view has recently received experimental support from the researches of Broca and Laporte. If the intrinsic brilliancy of a given luminous source is large, then when rays from that source are admitted to the retina, the intrinsic brilliancy of its image will be large and constant at all distances for a given iris aperture. The iris must tend to shut down, at any distance from that lamp until the local intensity or the brightness of the retinal image has reached a safe value.

Thus shutting down of the retina reduces the brightness of all other images in the field in like proportion, so that a printed page, or a diagram, in the field of view, will be seen very darkly, merely because somewhere on the retina a bright image has to be toned down to the safe local intensity. Obviously a much stronger illumination will be needed on the book or diagram in order to give a comfortable picture of it on the retina with the contracted iris. This artificially increased illumination may be quite unnecessary, and may represent much incidental waste of luminous power. On the other hand, if the arc lamp in the field of view were enclosed in a large opal diffusion globe, so as to reduce the intrinsic brightness of its light, the image of the lamp on the retina would be much larger, but it would also be much weaker in local intensity, and the iris would once more expand benignly. With the greater area of the pupil would come clearer seeing of all other objects, and a considerable reduction in foot-candles upon books or instruments might be comfortably permitted.

A good paper on the subject of intrinsic brightness was presented by Mr. J. E. Woodwell at the recent Philadelphia convention of the Illuminating Engineering Society. The paper points out that it is commonly considered advisable to reduce the intrinsic brightness of lamps in full view to 4 or 5 cp per square inch, but the paper advocates that the reduction should be carried much further—that is, down to 0.2 or 0.1 cp per square inch. This requires either concealing the lamps from direct vision or enclosing them in suitably large translucent diffusing covers. In either case, there is a danger of losing some light by absorption, but the loss incurred in this way may be more than made up in the general reduction of illumination suitable for use with eyes that are not stopped down under the stimulus of bright, shining objects, to say nothing of the hygienic advantages.

It would therefore seem to be possible that as the wastefulness and cruelty of hanging bright, naked lights in front of concert-hall audiences come to be recognized, through the development of illuminating engineering, architects and owners of such halls may find themselves open to lawsuits either for injuries or for nuisance. Hitherto ignorance has protected bad illuminating engineering. Some day ignorance may be no excuse.

Letters to the Editors.

Valuation of Public-Utility Properties.

To the Editors of Electrical World:

Sirs:—I note that Mr. F. E. Haskell, in a letter printed in your issue of March 18, questions my position in regard to the proper method of valuing public-service plants for rate making. I am very glad, indeed, that he has done so, believing that the question should receive the fullest possible discussion, but I regret that nothing in Mr. Haskell's letter directly concerns the heart of the matter, which is whether proper returns are a function of present or reproductive value.

My position is that water furnished through mains, or electric current sent over wires, 50 years old, have—provided the service is unimpaired—the same value to the consumer as though the mains or wires were new. If Mr. Haskell supposes, from my letter, that I do not appreciate the necessity for adequate depreciation reserves, he is quite wrong. I do not, however, think that the proper position to take in the case of a company which, either from inability or any other cause, has failed to provide for replacements, is one which must cause its final bankruptcy. If a company pays dividends out of capital, its punishment will arrive when it becomes necessary to rebuild, for the expenditures for rebuilding will not increase reproductive value, and hence not add to the value for rate-making purposes. It is well known that most new ventures in the public-utility line have all they can do to get enough money to cover actual cash requirements during the early years of their operation, and, to take the position that a depreciation reserve which cannot be laid aside then, shall not be made up later, is certainly unfair and unjust. The section of the public-utility law of Wisconsin covering depreciation reads, in part, as follows, in the original bill: "Every public utility shall carry a proper and adequate depreciation reserve." Upon being shown that such a requirement would mean rates being extremely burdensome to the consumers in the case of new companies or companies operating under adverse conditions, the section was amended by adding to the above, "whenever the commission after investigation shall determine that such depreciation account can be reasonably required," thus giving to the commission the right to postpone such accumulations and order them made up later.

I do not know what Mr. Haskell tries to show in his hypothetical case, but he has not quite understood my argument. He says: "In this case, the cash balance can be invested and the plant investment will not be burdened with earning dividends on the entire capital stock." My idea was that the purchaser must set aside a sum which, *together with its interest accumulations*, would equal the sum needed for rebuilding, and with this correction Mr. Haskell's hypothetical case appears to support my argument.

The answer to the statement, "It would be interesting to know what this would yield the investor when the new plant had been built and the expense of double depreciation removed," is that at this time the rates could—and should—be reduced somewhat. But what has this to do with my assertion that unless the purchaser *did* charge for "double depreciation," he would not have funds on hand to rebuild his plant when the time arrived to do so?

Mr. Haskell appears to think that, in the case of two companies exactly alike in every respect, save that one has money in the bank, representing depreciation in physical assets, while the other has not, the former should get higher rates than the latter. By what process of reasoning can the value of the service furnished be made to fluctuate with the bank balance?

About a year ago, in helping to prepare a brief, I used the following language: "In valuing public-service plants a distinction must be made between their values to the community and to their owners. The value to the community of a plant will always be its reproductive value—that is, the cost of a plant of the same capacity and extent. The fact that age, while

not diminishing its serviceableness, does bring nearer the time when it must be replaced, is one which concerns its owners only."

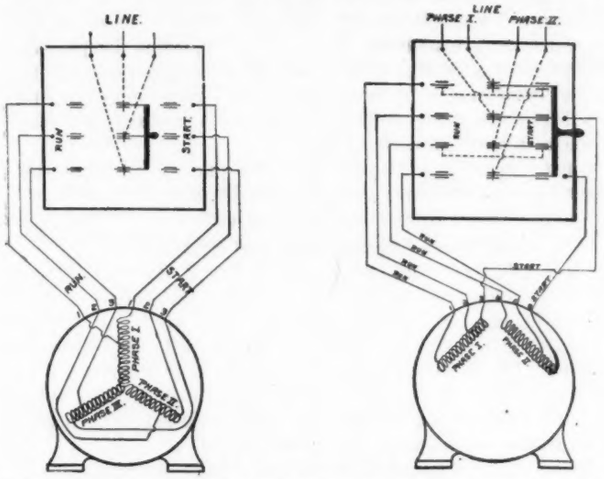
I believe that the essence of the matter is contained in the statement that the extent of the usefulness of a plant to the community is the proper measure of its rate-making value, and this usefulness is clearly, in turn, to be measured by its reproductive value.

SUPERIOR, WIS. W. H. WINSLOW.

The Starting of Induction Motors.

To the Editors of Electrical World:

SIRS:—Referring to the recent articles in your paper on the starting of induction motors, by Messrs. Bailey, Hanssen, Haar and Steinmetz, I am surprised to note that all of these have omitted to mention a scheme for starting a squirrel-cage motor which is better than the use of either the primary rheostat or the auto-transformer. This scheme is shown in the accompanying illustrations. Extra turns for starting are wound into the primary slots in the same manner and distribution as are the running coils. The machine has two sets of terminals: one set is for starting and the other for running. A double-throw oil switch connects to one or the other. The number of turns in the starting coils can be selected to suit the motor, and the starting current and torque are under control.



FIGS. 1 AND 2.—SELF-CONTAINED AUTO-TRANSFORMER ARRANGEMENT FOR THREE-PHASE AND TWO-PHASE MOTORS.

When connected to the starting terminals the machine exerts from 1.25 to 1.75 times full-load torque, and it will carry full load with usually about 15 per cent slip; on the running terminals the slip will be from 2.5 to 4 per cent, according to the size.

In performance this method is not materially better than an auto-transformer, but it does away with the auto-transformer losses and leakage; it is in fact the same as an auto-transformer with no core loss, no leakage, and very small copper loss, for the starting coils are wound with the same size of wire as are the running coils, and hence their resistance is low. The Richmond Electric Company has been applying this method for some years, and thousands of machines using the scheme have been built. The machine is complete in itself with no auxiliary apparatus except a standard double-throw switch.

As to expense, it adds about 40 per cent to the primary copper, about 25 per cent to the depth of the tooth, and about 1½ per cent to the stator diameter. It is cheaper than an equivalent auto-transformer.

RICHMOND, VA. E. J. WILLIS.

To the Editors of Electrical World:

SIRS:—There are two numerical errors in my article which appeared in your issue for March 11. In the third paragraph on page 633, the statement "from 1.5 to 2.0 times that of the starting torque" should read "two times the starting torque." In the fourth paragraph from the bottom of the first column on page 634 the value of the line current when the transformer-starter is used should be 1.5 instead of 5 times the full-load value.

RICHMOND, VA. E. J. WILLIS.

Reduction of Cable Rates.

To the Editors of Electrical World:

SIRS:—I notice in your issue for March 11, page 616, an item on reduction of cable rates in which you quote a newspaper interview with Mr. Thalberg. According to the arithmetic by which we are educated in this country, 300,000,000 words at 2 cents per word would amount to $6,000,000, and 25,000,000 words at 25 cents per word would amount to $6,125,000. I cannot, therefore, understand Mr. Thalberg's contention that the cable companies would make more money on $125,000 less revenue while at the same time they are obliged to furnish a staff for 12 times the amount of work. I only mention this as you do not appear to have commented on the fallacy of the argument.

MONTREAL, CANADA. W. J. CAMP.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Stray Flux.—M. SCHENKEL.—To determine the stray flux in an induction motor the rotor is removed from the stator, and each member is supplied with normal current independent of the other. By measuring voltage and power, the inductive component of the voltage is found, and from this it is possible to determine the stray flux of the whole motor. This method may therefore be used as a check upon the short-circuit test.—*Elek. und Masch.* (Vienna), Feb. 28.

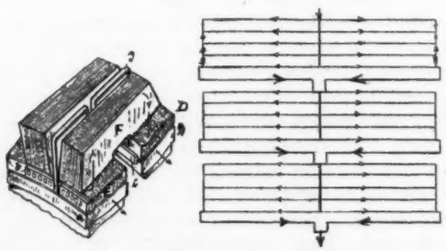


FIG. 1.—UNIPOLAR DYNAMO.

Unipolar Dynamo.—A note on a unipolar dynamo of F. Gahlish intended for higher voltages. The stationary armature is split up into a number of axial parallel conducting strips, which are connected together in series and parallel groups, as shown in Fig. 1 The magnet pole acts upon groups of short-circuited windings which lie in two armature rings axially connected by bridges of magnetic material. *F* represents pockets of stampings forming the poles; *C* and *D* are the laminated rings; *a*, *b*, *c* and *d* are the copper bars or segments.—Lond. *Elec. Engineer*, Feb. 19.

Lamps and Lighting.

Sixteen-Candle-Power Tungsten Lamps.—The German Welsbach Company has placed a 16-cp, 130-volt Osram lamp on the market. The lamp consumes 18 watts, or 1.12 watts per hefner

candle (approximately 1.3 watts per British candle). It is supplied for parallel running at the price of 50 cents, and in small quantities for series running at an extra charge of 6 cents per lamp. Supports for the filaments are provided at the ends of the loops, and the lamp can be used in any position. The normal lamp is pear-shaped, but spherical globes can be obtained at an extra cost. In the first week in February some of the Osram lamps previously put on the market were considerably reduced in price in Germany, thus the 40-cp and 50-cp, 200-volt to 250-volt lamps, which originally cost $1.25 apiece, are now listed at 87 cents. A reduction in the price of the 100-cp, 100-volt to 130-volt and 200-volt to 250-volt lamps to $1.12 was also made. The Wolfram Lampen Akt. Ges., of Augsburg, has also put a 16-cp, 100-volt to 130-volt tungsten lamp on the market. This lamp is also listed at 50 cents, an extra charge of 7 cents being made for spherical bulbs. Lamps for series running are listed at 6 cents extra. The consumption is stated to be about 1 watt per hefner candle. Other German and Dutch metallic-filament manufacturers have also reduced the price of their lamps. The Zirkon-Glühlampenwerk, Dr. Hollefreund & Company, are advertising a new lamp, the "double Z-lamp," with a consumption of 0.7 watt per hefner candle. A saving of 30 per cent in comparison with Osram and other metal-filament lamps, and 80 per cent in comparison with carbon-filament lamps is claimed, but the effect on the life of the filament of running at the high efficiency is not stated.—Lond. *Elec. Eng'ing,* March 4.

Tungsten-Zirconium Filament.—A note on a recent British patent (10,590, 1908; Feb. 25, 1909) of the British Thomson-Houston Company (General Electric Company of this country). Zirconium oxalate is used as a binder for forming a filament from powdered tungsten. As zirconium oxalate is gelatinous, no further binder is required. On heating to a high temperature, the filament sinters into a homogeneous body of tungsten and zirconium oxide, and has a high specific resistance—Lond. *Elec. Eng'ing,* March 4.

Enclosed Flame-Arc Lamp.—A note on a recent British patent of A. D. Jones (4977, 1908; Feb. 25, 1909). In order to enable impregnated electrodes to be used in an enclosed arc lamp, means for preventing the deposit of the ash on the glass globe must be provided. According to the present invention the globe is composed of two parts, an upper metal cap provided with external corrugations to keep cool, and a lower, transparent part maintained hot by means of an outer glass globe and an insulating air space. A rapid circulation of the fumes past the arc without local eddy currents is produced, and a white reflecting deposit forms on the cold upper metal cap, while the lower, transparent part of the globe is kept hot and clear. The globe is so shaped that a single vortex ring sweeps the whole inner surface, and it can be adapted for either vertical or converging electrodes. Not only are the burning-hours of the electrodes increased owing to the slower combustion by enclosing the arc, but the cost of electrodes should be considerably reduced.—Lond. *Elec. Eng'ing,* March 4.

Discharge of Electricity from Glowing Carbon.—J. A. Pollock and A. B. B. Rancland.—An account of experiments which were undertaken in connection with an investigation of the phenomena associated with the re-ignition of the carbon arc. For the object in view, an arrangement was required in which carbon rods should be situated somewhat as they are in an arc lamp, and in which the temperature of one of the rods could be readily controlled. The plan adopted was as follows: A cylinder of carbon, 4.5 cm long and 0.5 cm in diameter, was electrically heated, and a circuit was arranged to include an air-gap, of a few millimetres, between the middle point of the heated cylinder and the end of a comparatively cool carbon rod. The currents in the circuit were measured at different temperatures of the carbon cylinder—from 1100 deg. to 1800 deg. C.—and for various voltages across the air-gap up to the point at which an arc forms, with a view to finding the conditions under which the change from the non-luminous to the luminous discharge occurs in the case of hot carbon in air at atmospheric pressure. If I is the current of negative ions, E the potential gradient at the anode surface, and l the length of the last free run of the ions at the end of which they reach the anode surface, it is suggested that arcing commences when IEl attains a value sufficient to raise a part of the anode surface to such a temperature that positive ions are somewhat freely emitted.—*Phil. Mag.,* March.

Electron Theory of Carbon Arc.—J. A. Pollock.—The author shows that the application, to the case of the arc, of the idea of the projection of electrons from the surface of incandescent carbon leads to results as to the distribution of the potential between the carbons, in close agreement with the experimental facts discovered by Duddell.—*Phil. Mag.,* March.

Metallic-Filament Lamps for Isolated Plants.—To supply energy to a certain number of metallic-filament lamps the generating capacity of an isolated plant and hence interest and amortization are much less than with carbon lamps giving the same illumination. On the other hand, the renewal of lamps is more expensive. Nevertheless, it is shown in a table that even for isolated plants of comparatively smaller size the use of metallic-filament lamps becomes economical. This is even true for a relatively short number of hours of burning per year per lamp installed. The case of supplying lamps with energy from a storage-battery substation is somewhat similar. In the latter case it is recommended always to figure out first whether it would pay to replace the carbon lamps by metallic-filament lamps.—*Elek. Anz.,* March 4.

Hand Lamps.—W. Vogel.—The first part of an illustrated description of different forms of portable electric hand lamps for industrial purposes.—*Elek. Zeit.,* March 4.

Generation, Transmission and Distribution.

Indian Water-Power Development.—W. T. Taylor.—An illustrated description of the Jhelum River power development near Srinagar, India. The works are intended for a capacity of 20,000 hp at Mohora, but only 5300 hp will be utilized at present. The generating plant comprises four units, each of 1000 kw. Three-phase currents are generated at 3200 volts. For transmission the voltage is raised to 60,000. The article is to be concluded.—Lond. *Elec. Rev.,* March 5.

Regulating the Speed of Induction Motors.—C. Kraemer.—A translation of his recent German paper, in which he described a method for regulating the speed of induction motors whereby power corresponding to the slip is taken from the rotor and supplied again to the axis of the non-synchronous machine as mechanical power by means of auxiliary machines. The cost, advantages and disadvantages compared with other systems are discussed, and it is shown that the new arrangement is especially suitable for use in conjunction with rolling-mill motors and Ilgner sets.—Lond. *Electrician,* March 5.

Smoke Abatement.—A note on the opening of the smoke abatement exhibition now being held in Sheffield. Sir Oliver Lodge, in declaring the exhibition open, said that the ideal system of heating is a combination of the open-fire method and pipes, open fires in the rooms and pipes heating the passages. He depreciated, however, our present open coal fires. A better method is to separate the coke and gas, and in houses to burn gas only. He thought that before long gas will be used in large quantities for heating and cooking purposes, and electricity would be depended on more for lighting. He hopes that at an early date some town will try the experiment of having the gas made at the pit's mouth, where coal is cheap, bringing it to the consumers in pipes and forbidding the importation of crude coal into the town. He also mentioned, however, that a smoky flame is sometimes more efficient than a smokeless flame, as when water must be heated or where it is necessary to heat a cold surface by means of a flame. A possible remedy for the drawbacks of the present system might be the use of studs or projections on boiler plates, so that these studs could get red hot in the flame and carry the heat in by conduction. A kettle with a thick bottom which could get red hot would be more efficient than one of the ordinary kind.—Lond. *Electrician,* March 5.

Cleaning of Boiler Flues.—A note on the use of the vacuum-cleaning process for the removal of dirt in flues, etc., of large

batteries of boilers. The equipment required for the purpose includes a special pattern of two-cylinder vacuum pump, which can be driven off existing shafting, and runs at 180 r.p.m. This pump can be placed at any distance up to about 1,000 ft. from the boiler. Near the pump are placed a pair of vertical vessels acting as dust filters connected to the piping leading from the boilers. These filters are usually placed outside the building, under a roof, and sufficiently high to allow a cart to stand underneath, for the reception of the dirt, of which each filter when full holds about a cartload. The gun-metal cleaning nozzles are attached to flexible hosepipes connected to special fittings near the boilers and economizers, and 1.5-in. piping is used throughout. The standard size of equipment is capable of dealing with one ton of dust per hour, and with the two filter vessels no interruption is required for removal of the contents, as one can be filled while the other is being emptied. The system has been in use for two years at a large works in Bradford, and it is stated that one of the sections of the economizer containing 400 pipes can be cleaned out by two men in three hours, during which period about four cartloads of dust are usually removed. Previous to the installation of this equipment the cleaning of the economizer required the work of three men for about ten hours.—Lond. *Elec. Eng'ing,* March 4.

Traction.

Single-Phase Traction in Sweden.—A long abstract of a report prepared by R. Dahlander on electric traction on the Swedish State Railways. The report deals fully with the power-house, line and locomotive equipment, and with the difficulties encountered and with the ways in which they were overcome. In his conclusions Mr. Dahlander shows that the high voltages used during these tests are quite adaptable to ordinary working, that the effect of high-tension currents on telegraph and telephone lines can be reduced to a minimum, that the single-phase motor is now a reliable machine, and that 25 cycles is the best frequency to use. For Sweden, he considers, single-phase electric traction is the best system.—Lond. *Electrician,* March 5.

Installations, Systems and Appliances.

Electric Installation of a Department Store.—An illustrated description of the electric equipment of a department store in London. All of the cables and wires used are placed in solid-drawn, heavy-gage steel tubing, which in the case of the ground floor and all floors above, is concealed beneath the flooring. A very complete system of "earthing" has been provided. Energy is brought from a central station. The supply is on the direct-current, three-wire system, the pressure being 480 volts across the outers. This voltage is in most cases used for motors, 240 volts being the e.m.f. for the lamps. There are 6000 incandescent lamps—carbon, tantalum and osram—and 286 arc lamps. A very comprehensive system of electric clocks has been installed. This system is worked from one master-clock fixed in the telephone-room, and consists of 19 dials situated on the different floors and in the offices throughout the building. An impulse from the master-clock actuates the dependent mechanism in the other clocks every half-minute. The necessary impulse to keep the controlling pendulum swinging is imparted by a falling lever when the pendulum is passing through zero. This is the time when it has the least disturbing influence, and in order that the impulse shall not be a severe blow, the impulse pallet on the pendulum is so shaped that the impulse begins gently and increases to its maximum at zero, it then decreases in like ratio. In connection with these clocks a system of signaling is used containing a number of bells which can be connected in circuit at any desired time.—Lond. *Electrician,* March 5.

High-Tension Switchboard.—An illustrated description of a form of high-tension switchgear of German make, in which the oil switches, etc., can be withdrawn complete for inspection on wheeled carriages. The arrangement is particularly suitable for mining distribution boards, and for other conditions where the space is limited.—Lond. *Elec. Eng'ing,* March 4.

Electric Ignition.—J. LOEWY.—The conclusion of his long illustrated article, describing different systems of electric ignition for gas engines.—*Elek. Zeit.,* March 4.

Automatic Control Apparatus.—H. B. WHITE.—An illustrated description of automatic control apparatus in connection with electric operation of steel mills. They are chiefly of three types: time-limit control; counter-e.m.f. control, and current-limit control. Each one of these systems has its special advantages. The author describes control equipments for 2000 hp and 6000 hp, 6600-volt induction motors for the Indiana Steel Company's rail mills at Gary.—*Gen. Elec. Rev.,* March.

Free Oscillations in Long Lines.—I. DOERY.—The conclusion of his mathematical paper. The author discusses the use of condensers as protection against dangerously high voltages. It is shown that a condenser is not only practically almost useless for this purpose, but also has direct disadvantages. The discussion of the problem is based on a mechanical analogy.—*Elek. und Masch.* (Vienna), Feb. 7.

Wires, Wiring and Conduits.

Armoring for Trailing Cables.—A note on a recent British patent (15,641, 1908, Feb. 18, 1909), of the British Insulated & Helsby Cables, Limited, and F. A. Cole. When trailing cables used in connection with portable machinery or for temporary work are protected with an armoring of round steel wire wound spirally, kinking readily occurs, because the wire covering is easily displaced. According to the present invention it is proposed to cover such cables with steel tape or strip wound spirally, the turns being spaced slightly apart. For example, a cable 1 in. in diameter would be wound with strip measuring ¼ in. wide by 1/3 in. thick, and a space of 1/16 in. wide would be left between adjacent turns. A cable armored in this way cannot be bent beyond a certain limit, because the square faces of the strip bear against one another.—Lond. *Elec. Eng'ing,* Feb. 25.

Electrophysics and Magnetism.

Positive Ions from Hot Platinum.—F. C. BROWN.—An account of an investigation into the magnitude and the mode of distribution of the kinetic energy of the positive ions emitted by hot platinum. The experimental research of the author shows a close agreement between the value of the kinetic energy and that required for thermal equilibrium. This would appear to militate against the somewhat prevalent idea that the positive ions arise from chemical action. In that case one would expect the kinetic energy of the emitted ions to be increased by the heat of reaction. The small value of e/m recently obtained for the positive ions—384 for platinum—by Richardson, indicates that they are not positive electrons. The balance of evidence appears to be in favor of the view that they are atoms or molecules of some foreign substance emitted from the metal by a process similar to evaporation and involving small thermal changes. The matter can hardly be regarded as definitely settled.—*Phil. Mag.,* March.

Absorption of Radioactive Emanations by Charcoal.—R. W. BOYLE.—An account of an experimental investigation of the absorption of thorium emanation by means of charcoal under different conditions. The absorption depends on the nature of the charcoal used, being greatest for cocoanut, intermediate for animal, and least for wood charcoal. It is decreased by increasing the velocity of the gas current which conducts the emanation through the charcoal. It is increased by increasing the charcoal absorbing surface; it depends on the temperature, following the law for ordinary gases, namely, that a lowering of the temperature of the charcoal causes an increase, and a raising of the temperature a decrease, in the amount of absorption.—*Phil. Mag.,* March.

Diffusion of Actinium and Thorium Emanations.—S. RUSS.—An account of an experimental investigation. The diffusion of actinium emanation in gases, such as air, hydrogen, carbon-dioxide, sulphur-dioxide, and argon, shows no considerable deviations from the ordinary laws of diffusion. The variation with pressure of the coefficients of diffusion of the actinium and thorium emanations appears to be quite regular down to pressures of a few centimeters. A comparison of the diffu-

sion coefficients of the actinium and thorium emanations in air under similar experimental conditions gives the ratio of their molecular weights as 1.42, that of thorium being the heavier.—*Phil. Mag.*, March.

Secondary Gamma Radiation.—J. P. V. Madsen.—An account of an extended experimental investigation into the properties and nature of secondary gamma radiations.—*Phil. Mag.*, March.

Electrochemistry and Batteries.

Determining the Condition of a Storage Battery.—To determine the condition of discharge of a storage battery, a voltmeter is generally used, and one is satisfied if this shows about 2 volts per cell on open circuit. However, such a measurement is not exact, since the real condition of the battery is better indicated by the voltage at its terminals while being discharged at normal current. To make such a test a resistor of proper resistance may be connected in parallel with the battery and the voltmeter. Fig. 2 shows an instrument which combines the voltmeter and the resistor in one apparatus. The resistance of the voltmeter is so chosen that the battery, while being tested at normal voltage, is being discharged with normal current. For two-cell batteries, its scale is from 3 volts to 5 volts. The instrument is intended only for instantaneous measurements, as otherwise it would get unduly hot.—*Elek. Zeit.*, March 4.

FIG. 2.—VOLTMETER FOR TESTING STORAGE BATTERIES.

Ferrosilicon.—E. Escard.—The first part of an article on ferrosilicon. In the present installment the author deals with the compounds $Si\ Fe_2$, $Si_2\ Fe_3$, $Si\ Fe$, $Si_2\ Fe$ and $Si_3\ Fe$.—*La Lumière Elec.*, March 6.

Units, Measurements and Instruments.

Measuring Small Inductances.—C. J. Watson.—When experimenting with very rapid electric oscillations it becomes necessary to measure very small inductances. A simple arrangement of doing this is illustrated in Fig. 3, which shows a kind of Wheatstone bridge, in which two inductances are balanced against two capacities, a vacuum tube being used instead of a galvanometer to indicate the equilibrium. The bridge is fed at two opposite points by the oscillating potentials of the outsides of two Leyden jars, K_3 and K_4, of which the insides are connected to an induction coil capable of giving a 2-in. spark. In order to measure the unknown inductance L_1, a pair of bare copper wires, L_2, is stretched as far as space will admit and maintained at a uniform distance, while a movable bridge allows more or less of them to be brought into action. The inductance of the latter can be calculated. It is advantageous to prepare a number of inductors of calibrated variable inductances in the form of coils containing different numbers of turns. When each of these is substituted for L_1, and the induction coil is set in action, the vacuum tube will usually become luminous, but on sliding the movable bridge there will be found a space limited to a few centimeters, which will cause nearly the total extinction of the tube, and the middle of this may be taken as the correct position. Having thus obtained inductors of calibrated variable inductances, the parallel wires, L_2, may advantageously be dispensed with, and the graduated coils used in their place, because the observer is thus enabled to remain close to the inductance bridge. Some interesting experiments can be made with this apparatus. Thus, an inductance of 6600 cm in series, with a capacity of 908 mf, was balanced by an inductance of 2720 cm; but when a capacity was placed in parallel with an inductance, the value of the latter was increased. This, which seems at first sight paradoxical, follows from the fact of the resistances being negligible with very rapid oscillations.—Lond. *Electrician*, March 5.

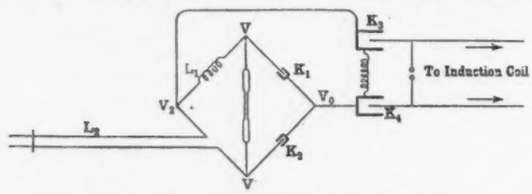


FIG. 3.—MEASURING SMALL INDUCTANCES.

Potentiometer on Alternating Current.—C. V. Drysdale.—His full British Physical Society paper on the use of the potentiometer in alternating-current circuits. An abstract of this paper has already been noticed in the Digest.—*Phil. Mag.*, March.

Direct-Current Amp-Hour Meters.—J. Busch.—Amp-hour meters which contain a motor running in the field of a permanent magnet and are in parallel with a shunt in the main line have many advantages. The author has found that they are susceptible to errors due to mercury vapors. While mercury vapor is seldom encountered under ordinary conditions of practice, errors of this kind may occasionally occur in laboratories, testing plants, etc. Mr. Busch recites one case in which amp-hour meters of the above kind were repaired simultaneously with other meters having a mercury filling; it was then found that the first meters showed irregularities and a special investigation proved that these were due to mercury vapor in the atmosphere. The source of the trouble is at the contact between brushes and commutator; when this contact is attacked by mercury vapor the meters are retarded and the retardation increases with decreasing load.—*Elek. Zeit.*, Feb. 25.

Telegraphy, Telephony and Signals.

Telephone Exchange.—H. S. Plymen.—An illustrated description of the Midland telephone exchange in Birmingham. Details are given of an improved method of party-line working. Associated with each party line are two multiple jacks, but only one answering jack and calling lamp. The answering jack and one of the multiple jacks are cross-connected at the intermediate and main distributing frames in the usual manner; the second multiple jack is cross-connected to the answering jack at the intermediate frame, but the *A* and *B* wires of the jumper are reversed at the horizontal side. This method of cross-connecting is shown in Fig. 4; it will be seen that an operator on one multiple jack rings over the *A* side of the line, and on the other multiple jack over the *B* side, in each case ringing the subscriber or subscribers on the one side only.

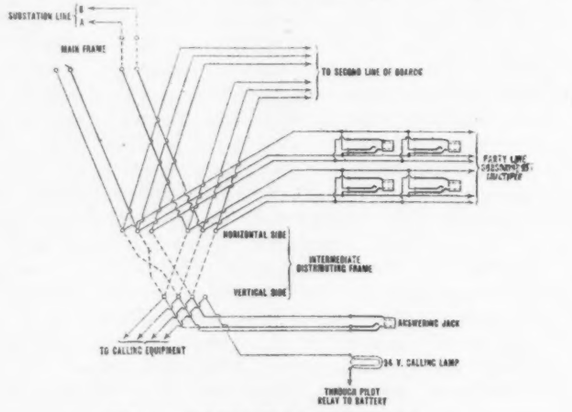


FIG. 4.—DIAGRAM OF CONNECTIONS.

The two subscribers on a two-party line will thus have two distinct numbers, which may or may not be consecutive.—Lond. *Elec. Eng'ing,* March 4.

Automatic Telephone Exchange.—KRUCKOW.—The conclusion of his illustrated description of the automatic telephone exchange of Hildesheim, using the Strowger system. This is the first automatic telephone exchange in Germany.—*Elek. Zeit.,* March 4.

Automatic Telephony.—W. L. CAMPBELL.—A Franklin Institute paper, describing the Strowger system of automatic telephone exchanges.—*Jour. of Franklin Inst.,* March.

Electric Clocks.—W. KREJZA.—A review of the different types of electric clocks now on the market.—*Elek. und Masch.* (Vienna), Feb. 28.

BOOK REVIEW.

ELEKTRO-ENGENIEUR KALENDER, 1909. Edited by Arthur H. Hirsch and Franz Wilking. Berlin: Oscar Coblentz. 324 pages. Price, 2.50 marks.

The ninth year of this useful little handbook maintains its character of previous years, the editors so selecting and condensing the contents as to keep the volume to a size actually to that for a pocket. The book is intended particularly for the working electrician, and the matter is, therefore, confined to practical information. The usual pair of blank memorandum books for loose insertion within the covers come with the book, and one of the two pockets in the flap cover contains an envelope enclosing commercial samples of drawing, tracing and cross-section paper.

NEW APPARATUS AND APPLIANCES

Insulating Transformer for Telephone Lines.

An insulating transformer for use on telephone lines has recently been placed on the market by the General Electric Company, the purpose of which is two-fold: First, to safeguard the users of telephones from the dangers of high voltages due either to induction or accidental contact between telephone and power lines, where these lines are on the same pole or upon a parallel adjacent line of poles; and second, to improve the telephone service by removal of the ordinary small ground-gap carbon arrester from direct connection with the line, as well as improvement through better insulation by removing the interior wiring, instrument, batteries, etc., from direct connection with the line.

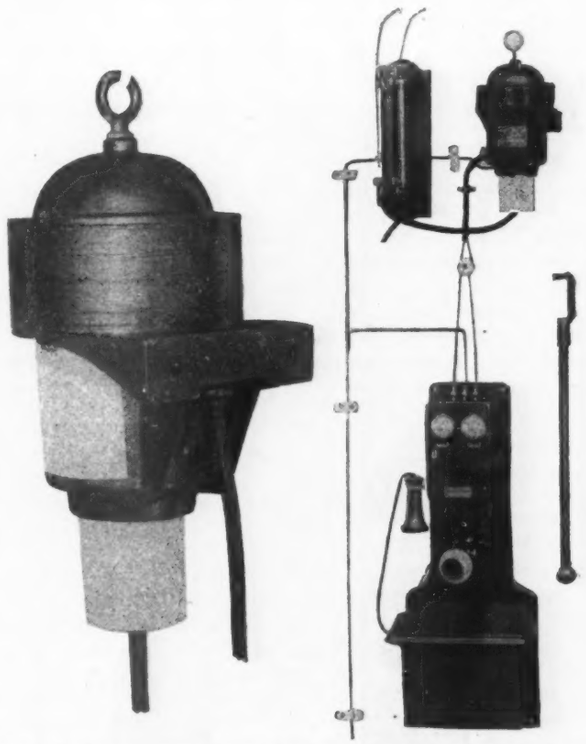
Special attention has been given to the electrical and mechanical design of the transformer; the high-frequency talking currents are transformed with small loss, while at the same time the magnetizing current, which must be supplied by the ringing generator, is very small. Tests show that the magnetizing current taken by this transformer is about half the current passed by a standard 1000-ohm bell. As can be seen from Fig. 1, the insulating transformer is assembled in a weatherproof iron case and may, if desired, be installed out of doors and mounted in any convenient place.

In designing this transformer the insulation has been considered of primary importance. A high-potential test between windings of 25,000 volts for one minute is given to each transformer before shipment. The high insulating quality assured by this test makes the transformer a sturdy piece of apparatus under ordinary conditions of operation, but the best protection is afforded when it is installed with a combined switch, fuse and lightning-arrester. This combination affords the greatest safety to both the telephone instruments and the user, even in the most extreme cases when the telephone lines come in actual contact with a high-tension power circuit.

The switch, fuse and lightning-arrester combination recommended for this service is shown at the top of Fig. 2, the whole being mounted on a base of insulating material. The long-handled insulated hook at the right of the illustration is used to pull the switch open when it is desired to disconnect the telephone and transformer from the line. The arrester is hinged at the bottom, the insulated hook engaging with a ring at the top of the arrester. The usual form of carbon arrester with mica separation is used to protect the winding of the transformer against any abnormal difference of potential which might accidentally exist between the telephone lines. This arrester is connected across the terminals of the transformer, but is not connected with the ground.

An adjustable gap-arrester is connected between the telephone lines and ground, the function of this arrester being to take care of lightning discharges, and in case of actual contact with high-tension lines, to arc over and blow the fuse, thus disconnecting the transformer and telephones from the line. Should a ground occur on the adjacent high-tension line, the voltage induced on the telephone line will not materially interfere with the service, provided the line is sufficiently well insulated. The adjustable air-gap is set just beyond the point where this induced voltage will arc across.

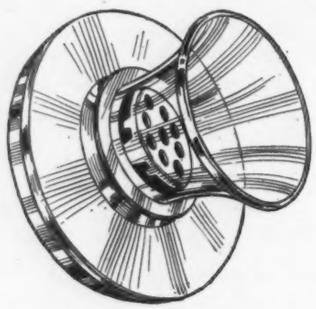
Tests on a 30,000-volt transmission line in actual operation showed that a ground on one phase of the transmission system induced a potential on the telephone line of approximately 7000 volts, measured between telephone line and earth. Notwithstanding this high-induced voltage on the telephone line it was possible to use the telephone when the transformer was installed. The line was somewhat noisier than under normal conditions, but not so noisy as to prevent satisfactory conversation.



FIGS. 1 AND 2.—INSULATING TRANSFORMER AND ITS APPLICATION.

Telephone Mouthpiece of Glass.

Glass mouthpieces are coming into use on telephone transmitters because they can be readily removed and cleaned or boiled if necessary to kill disease germs. The illustration shows a new glass mouthpiece invented by Mr. M. M. Wood and manufactured by the Commercial Appliance Company, 135 Adams Street, Chicago. The device is made in two parts—a metal base containing a perforated cap and the glass mouthpiece proper. Metal tongues on the base are adapted to engage the thread of transmitter openings of various sizes. By this means the base is screwed onto the transmitter after the ordinary hard-rubber mouthpiece has been detached. The glass mouthpiece is simply snapped onto the metal parts by pressure and can be removed in an instant. It is less liable to breakage than the hard-rubber mouthpiece and is said to have better "talking qualities."



GLASS TELEPHONE MOUTHPIECE.

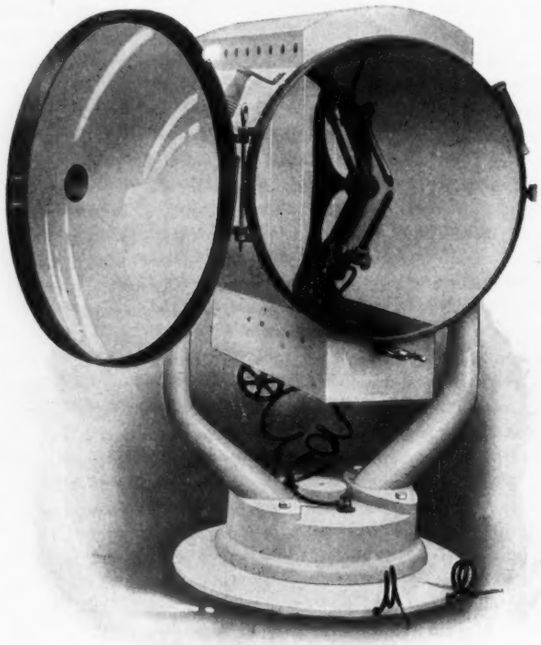
Pull Socket for Standard Incandescent Lamps.

Two objections to the ordinary chain-pull sockets have been the difficulty in attaching the shell and cap when installing the socket in a husk, and the time required to wire the socket because of the necessity for removing and replacing the pull chain. The Bryant Electric Company, of Bridgeport, Conn., has brought out a socket which is said to meet the approval of the Underwriters and which can be quickly placed in a husk and also allows the pull chain to be installed at any desired point in it. By mounting the chain guide on the socket mechanism instead of on the shell it is possible to install the socket without removing the chain. These results have been obtained without disfiguring the symmetry of the socket. The switching mechanism is of the quick make-and-break type and the screw for regulating the tension of the spring used in pulling back the chain is easily accessible. This will doubtless be found convenient when it becomes necessary to substitute a chain of different length. The tension may be varied without removing the screw from its seat by simply turning it with a screwdriver to the desired position, where it is automatically held. The "New Wrinkle" socket combines the elements of strength, durability, neatness, etc., which characterize the company's output.

FIGS. 1 AND 2.—PULL SOCKETS.

Alternating-Current Searchlight.

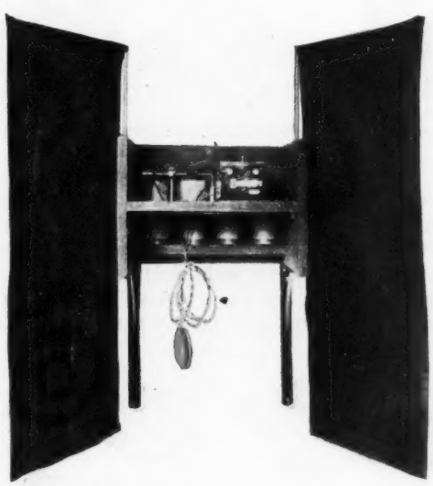
Commercially, an alternating-current searchlight has generally been considered impractical. The Carlisle & Finch Company, of Cincinnati, Ohio, has spent considerable time experimenting on the problem and has succeeded in making lamps which will burn on 60 cycles. The secret of the success is said to be due to the position of the carbons. Referring to the illustration showing the reflector swung back, it will be noticed that the carbons, instead of being horizontal or vertical, are placed at an angle of 90 deg. with each other and at an angle of 45 deg. with the axis of the reflector. The carbons are fed by means of right-and-left screws which are caused to rotate at the same speed by a pair of bevel gears. Motion is imparted to the screws by means of a laminated shunt magnet, which operates a pawl-and-ratchet movement. A starting magnet separates the carbons when the lamp is switched into circuit, and after the lamp has burned long enough to have a difference of potential across the arc of 50 volts the current which passes through the shunt magnet begins to operate the pawl-and-ratchet feed and the carbons are thereafter gradually fed together as fast as they are consumed. A peep-sight is placed directly in the center of the reflector so that the arc may be observed. The ray of light thrown by the lamp, while not as concentrated or as penetrating as that from a direct-current lamp, is yet quite satisfactory and will carry from one-half to three-fourths of a mile. The light itself can be seen for many miles, but the effective range at which objects can be distinguished by the operator of the searchlight is about three-fourths of a mile. The apparatus is especially serviceable for small parks and for amusement resorts, the operation of the lamp being entirely automatic. Silvered copper reflectors or Mangin mirrors are provided with the equipment.



ALTERNATING-CURRENT SEARCHLIGHT.

Lamp Vacuum Testing Apparatus.

The life and efficiency of an incandescent lamp depend to a considerable extent upon the degree to which the bulb has been exhausted, and in order that the amount of vacuum may be readily and relatively ascertained, the Dwyer Machine Company, of Lynn, Mass., has devised a testing set for the purpose. A high-potential coil giving approximately 20,000 volts is discharged through the lamp, and of course the color of the luminous gas is an index of its density and kind. The instrument consists of a case divided into two compartments with black curtains hung on the sides to exclude the light as shown in the accompanying engraving. The testing coil, etc., are placed in the upper compartment while the lower compartment is fitted for making the tests by bringing the lamp base in contact with a brass disk projecting into the chamber, while the operator at the same time operates a pedal switch. The condition of the vacuum is indicated by the resulting phenomenon. The gas will glow with a purple, red, pink or white color, or not at all, according to the degree of the vacuum within. A lamp containing a considerable amount of air shows purple streamers branching from the filament to the glass. Such a lamp probably contains a crack in the glasswork and will burn out in a minute or two. A red glow uniformly distributed throughout the bulb indicates a better vacuum than the above. This lamp contains a little air and the candle-power will



LAMP VACUUM TESTING APPARATUS.

drop very rapidly, probably down to 10 cp within an hour. A lamp with a white glow with the slightest tint of pink close to the glass is slightly better than the above. A lamp with a whitish glow, but showing the filament very distinctly and with a marked glow about the joints while containing a better vacuum than the above, is still a very poor lamp and will deteriorate very rapidly. A lamp with a white glow uniformly distributed throughout the bulb may burn a hundred or two hundred hours without burning out, but the candle-power will drop rapidly. A lamp with a thin whitish glow more or less intermittent and sometimes hard to start is one which lamp manufacturers sometimes pass as satisfactory. After such a lamp has burned for about half an hour the glow will usually be found to have disappeared. Such a lamp will drop in candle-power much more rapidly than one with a perfect vacuum. A lamp which shows an intermittent flicker of light on the inside surface of the bulb contains a very good vacuum. Such lamps are universally passed as excellent by the manufacturers. A lamp which shows no glow whatever possesses a still higher degree of vacuum than the above, and as this "glow test" is the most severe test known for vacuum it is as high as the lamp manufacturers can obtain, and such lamps may be considered perfect. A lamp which is completely full of air cannot be made to glow.

Electricity at Railway Appliances Exhibition.

Electrical apparatus is used to such a large extent by the steam railroad companies of the country that the exhibition of railway appliances held at the Coliseum, Chicago, March 15 to 20, could not fail to contain much to interest and instruct the electrical man. The display was a large one and of much excellence, containing about 120 exhibits of a large variety of machinery and appliances used by railroads, arranged by the Road and Track Supply Association. The tenth annual convention of the American Railway Engineering and Maintenance of Way Association was held at the Auditorium Hotel, Chicago, during the exhibition at the Coliseum, and the engineers attending it were, of course, among the most interested visitors at the exhibition. Following are brief references to some of the exhibits of particular interest to electrical visitors:

The American Steel & Wire Company, Chicago, had a large space in which were shown rail bonds, tools for rail bonding, rubber-covered wires and cables and other products of the company's factories.

The Blake Signal & Manufacturing Company, Boston, displayed dispatchers' selective train-order signals for use with telephone train dispatching.

The Bryant Manufacturing Company, Chicago, had an exhibit of railway signaling supplies, including mercury contact relays, automatic motor signals, switch indicators, battery chute cases, lightning arresters and the like.

The Joseph Dixon Crucible Company, Jersey City, N. J., had an exhibit, and the representatives of the company were always willing to talk about graphite brushes for motors. There was also a display of lubricating graphite for different purposes.

The Duntley Manufacturing Company, Chicago, attracted attention by a motor-electric car for section work, equipped with a 7½-hp gasoline engine driving a 2-kw, 110-volt, direct-current dynamo. The gasoline engine is arranged to operate the car to any point on the line where its services may be necessary for repair work. It is then connected to the dynamo, which furnishes electricity for a number of portable electric tools. This outfit of small machine tools consists of an emery wheel, a wood-boring drill, a spike-driving drill and four rail-bonding drills, each driven by a small electric motor mounted on the tool and forming a part of it. This company also demonstrated its standard vacuum cleaner, operated by electricity, arranged to be connected to any incandescent electric light socket and to remove dust and dirt from floors, rugs, furniture, etc., by the vacuum process.

The Edison Manufacturing Company, Orange, N. J., displayed Edison primary batteries and "BSCO" primary batteries for railroad signaling. The letters BSCO represent the Battery Supplies Company, and this type of battery has been recently brought out. In designing this new battery an attempt has been made to reduce the labor cost of renewal, at the same time increasing the current-producing capacity and reliability of the battery. The renewal parts consist of elements assembled in one piece—a can of soda and a bottle of oil. In addition to the ordinary caustic-soda solution, the BSCO battery is also supplied with a special low-temperature solution for use where the batteries are required to operate in very cold weather.

The Electric Storage Battery Company, Philadelphia, showed types of its storage batteries particularly adapted for car lighting and signal service. It also distributed an illustrated account of electrically operated drawbridges at which storage batteries are installed and kept "floating" at all times on the system supplying the electricity so as to be instantly available in the event of any derangement.

The H. W. Johns-Manville Company, New York, made an interesting display of its products. Of particular electrical interest were lamps, the Linolite lighting system, strain and globe insulators, overhead material, catenary-construction material, tape, a full line of fuses and fuse blocks, insulators and car heaters.

The Kerite Insulated Wire & Cable Company, New York,

had a large exhibit of its insulated wires and cables. Samples of the different classes of wire were attractively displayed, and there were also large balls of Para rubber, one being said to weigh over 700 lb. Kerite is one of the oldest of the insulations used for conductors in electrical work, and it was specially mentioned for its merit in the report of the rubber-covered wire committee of the Railway Signal Association last June.

W. N. Matthews & Brother, of St. Louis, displayed their well-known "money-saving" specialties, devoting particular attention to the Matthews guy anchor, which screws into the ground like a lag screw into a pole. When it is screwed into the ground 5 ft., it is set and there is nothing further to do but to attach the guy wire. Other specialties displayed included telephone jack boxes, plugs for dispatching systems, cable clamps, cable splicing joints and lamp guards.

Other electrical exhibits were made by the Union Switch & Signal Company, Alamo Manufacturing Company, Bryant Zinc Company, Buda Foundry & Manufacturing Company, Dake-American Steam Turbine Company, Fairbanks, Morse & Company, General Railway Signaling Company, Hall Signal Company, C. F. Massey Company, Geo. P. Nichols & Brother, C. F. Pease Blueprint Machinery & Supply Company, Pennsylvania Steel Company, Pittsburgh Steel Company and Sandwich Electric Company.

Metal Molding and Fittings.

As is probably well known, metal molding has been approved by the Underwriters for open work for a number of years, although the introduction of the system has been somewhat re-

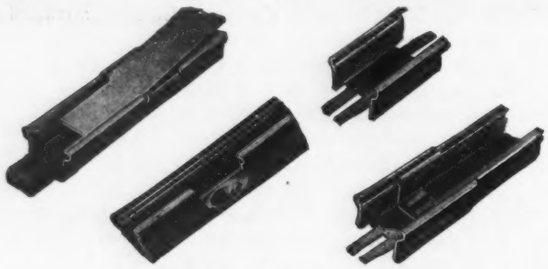


FIG. 1.—METAL MOLDING.

tarded because of the unfamiliarity of wiremen with the product. The molding, however, is now rapidly coming into use as a substitute for wooden molding and also as a substitute

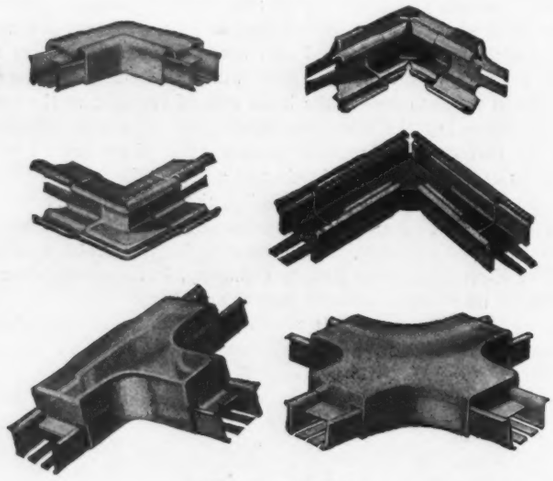


FIG. 2.—ELBOWS.

for conduit when the latter must be exposed. The "Lutz" metal molding, manufactured by the American Circular Loom Company, of Boston, Mass., is illustrated herewith. As is shown by the illustrations, the molding forms a steel raceway of suitable dimensions for two wires or twin wires which are placed in the trough. The molding comes in 10-ft. lengths and is electro-galvanized inside and out. The flexible metal capping slides in two flanged grooves, thus entirely closing the raceway and protecting the wires. The base is provided with countersunk holes at intervals for screws or nails used in fastening the base to the wall or ceiling. The capping can be removed at either end or at any point desired by making two hack-saw

FIG. 3.—ADAPTERS.

cuts through the flanges of the base and slightly opening the cut portion so as to release the end of the capping. The lengths of molding are coupled or bonded together with proper fittings as required. The method of installing the fittings consists in cutting slots with a hand punch or an ordinary fine-toothed tubing saw in the ends of the bases to be connected, about ½ in. from the ends. The prongs of the coupling are

FIG. 4.—PORCELAIN RECEPTACLE, ROSETTE AND SWITCH BASE.

bent and inserted in the slots and the couplings snapped over the flanges of the base and the prongs bent down. Elbows and tees have prongs similar to those on the couplings and are connected with the base in the same manner. For the purpose of connecting the molding with rigid conduit and also with panel boards, adapters are used. These fittings have recessed chambers to engage with the exterior flanges of the base, and

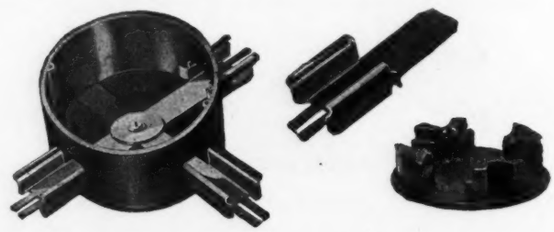


FIG. 5.—OUTLET BOX.

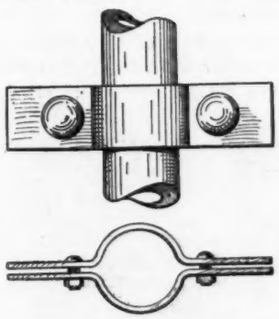
lugs to preserve the capping from contact with wiring connections. They are also threaded so as to be readily connected with rigid conduit fittings. Porcelain rosettes, receptacles and switch bases are made to straddle and fit the molding. They are furnished with wiring connections and have lugs against which the capping butts to keep it from contact with the connections. Outlet boxes are made for various uses and are

FIG. 6.—FIXTURE STRAPS.

provided with either special outlet bonds or recessed chambers to engage with the base. No outlet bushings are required. Fixture straps and toggles are provided as necessary adjuncts of the system. The accompanying illustrations show the various fittings in the line and will doubtless suggest uses for the molding where ordinary wooden molding is not applicable and where conduit would be barred because of greater expense.

Pipe and Conduit Clamp.

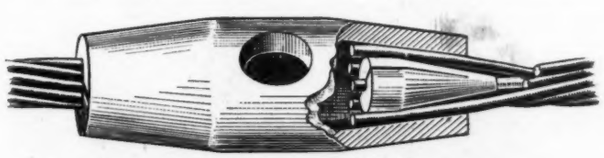
The line of pipe and conduit clamps made by the H. Krantz Manufacturing Company, of Brooklyn, N. Y., is made of steel and in three styles. One style has even sides and a bolt on each side; a second style has two extra long sides and two bolts on each side, the pipe being carried centrally; while still another style has a short side with one screw and a long side with three screws. The clamps are made to take pipe from ½ in. up to 3 in., and the square shoulders of the bolt is said to prevent its turning when the nut is screwed on. The first style of clamp mentioned is shown herewith.



PIPE AND CONDUIT CLAMP.

Messenger Splice.

Frank B. Cook, of Chicago, Ill., has placed on the market a messenger splice which has been tried out in practice and found to be valuable for the uses for which it was designed. Wherever messenger strands can be or need be spliced, the device is applicable without the use of tools. It is claimed that a complete splice can be made by any ordinary lineman within two minutes, and that the splice will be stronger than a Siemens-Martin strand. Ordinarily, if a cable-supporting messenger runs short, it means a splice, and this not only requires time and is expensive, but can only be made by an experienced man.



MESSENGER SPLICE.

With the Cook splice this operation, it is said, can be performed by anyone. Moreover, in practice, short lengths of strand are either thrown away or consigned to a miscellaneous junk heap for future use. With the splice shown herewith these short lengths of strand can be used up to advantage. These are the principal points of advantage claimed by the manufacturer, the splice also embodying the elements of low cost and reliability.

Electric Motors on Docks.

The convenience of electric motive power is well illustrated in the applications shown in the accompanying views, where electric motors are shown connected to a capstan and a winch for use in hauling vessels up to the dock. In each case the outfit is entirely self-contained, with the entire outfit on a single bedplate, which insures correct alignment of the gearing even after long service. This construction makes the installation of the outfit a simple matter, as it is only necessary to bolt the bedplate to a secure foundation and connect the motor to the power circuits. The location of the capstan may be chosen without reference to the power, for the wires may be run anywhere on the dock with much greater convenience at a substantial saving as compared to any other method of supplying power.

Fig. 1 shows one of the two electric capstans supplied by the American Ship Windlass Company, of Providence, R. I., to the Newport News Shipbuilding & Drydock Company, which are installed on piers in its shipyard at Newport News, Va. With a capstan on each pier at the entrance of the dry dock, it is possible to haul the ships in very rapidly and accurately. The dock is one of the largest at any of the shipyards in the world, and will take the largest American battleships now afloat. It may readily be appreciated that powerful machines

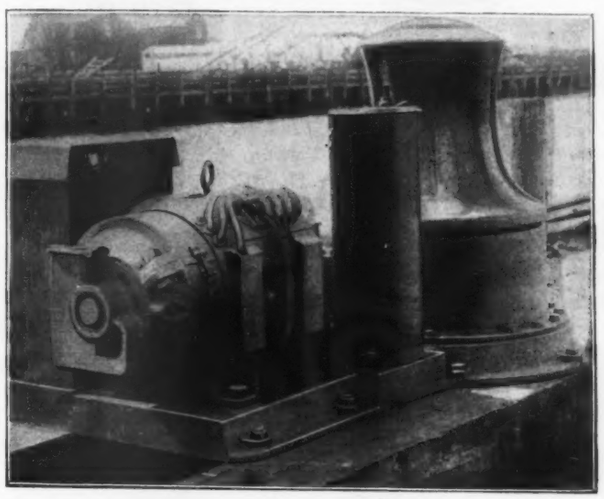


FIG. 1.—ELECTRIC CAPSTAN.

are required to do such work. Each winch is designed to pull 11,000 lb. at 30 ft. per minute. The motors are standard Westinghouse series-wound motors running at a full load speed of 560 r.p.m. The speed is controlled by a standard Westinghouse controller. The capstan is known as a 16-in. electric "gypsy"; that is, the barrel is 16 in. in diameter at its smallest part. The hauling rope is merely wound around the barrel four or five times and the loose end of the rope overhauled as the vessel is pulled into the dock by the winches.

Fig. 2 shows a powerful winch which was installed by the Interborough Rapid Transit Company, of New York, to haul barges alongside of the dock at its power station. It is driven

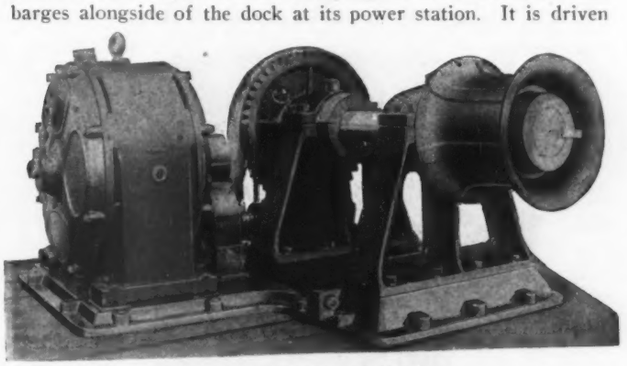


FIG. 2.—ELECTRIC WINCH.

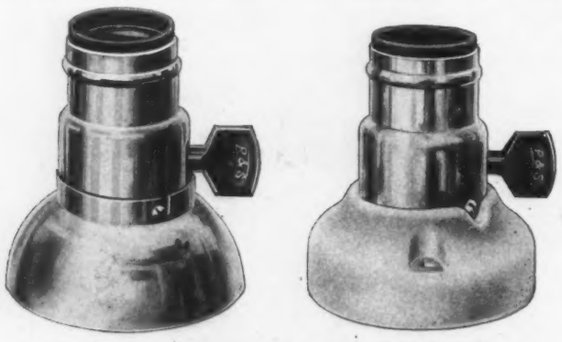
by a 25-hp, three-phase induction motor of Westinghouse manufacture. With the motor running at 240 r.p.m. the winch has a speed of 24 ft. per minute, and exerts a pull of 18,000 lb.

It will be noted that in the first case at Newport News series-wound, direct-current motors are used, and in the second case at New York a three-phase induction motor of the short-circuited secondary type is employed. In each case the conditions are practically the same, and the different types of motors are giving satisfactory service. All of the winches were furnished by the American Ship Windlass Company, of Providence, R. I.

Lamp Receptacles for Concealed Wiring.

In the accompanying illustrations there are shown two styles of lamp receptacles recently developed for use with concealed wiring. The receptacles are built with large bases, thereby providing wide separation of the supporting screw holes, so that the receptacle can be properly fastened in a workmanlike manner.

The lamp receptacle illustrated in Fig. 1 is intended for replacing the removable rubber ring fastening which is not now



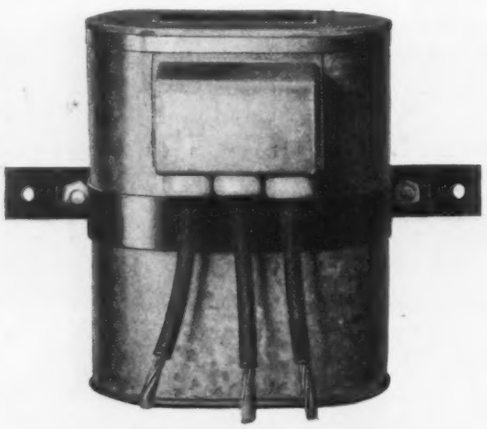
FIGS. 1 AND 2.—WIDE BASE LAMP RECEPTACLES.

sanctioned by the Underwriters. The base is recessed to allow for the projection of tubes on conduit ends. The style shown in Fig. 2 also has the latter feature, but it is equipped with an all-porcelain base. The two types here illustrated are provided with keys; similar keyless receptacles have also been developed for them.

These devices have been placed on the market by Pass & Seymour, Inc., Solvay, N. Y.

Transformer for Electric Signs.

Breakage of the fine filament of the ordinary tungsten lamps is a life-shortening obstacle not yet entirely overcome. On low-voltage lamps a thicker filament is employed so that the breakage is greatly reduced and the life increased to about 2000 hours. To take advantage of this condition and also of the increased economy possible by the use of tungsten lamps, low-voltage tungsten lamps have been employed in a number of places. For central stations operating signs on a flat-rate



TRANSFORMER FOR ELECTRIC SIGNS.

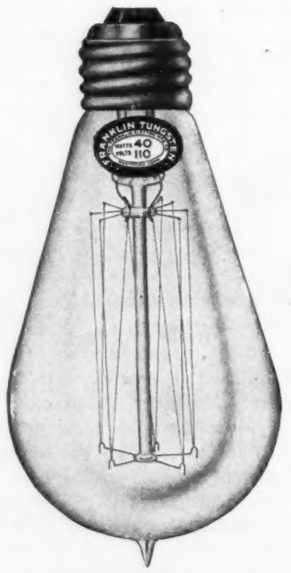
basis, it may be interesting to know that the Enterprise Electric Company, of Warren, Ohio, has brought out a Peerless type transformer especially applicable for sign circuits in conjunction with 4-cp, 10-volt tungsten lamps. The transformers are built with silicon steel cores and are mounted in sheet-steel cases provided with hangers. The design of the transformer in other respects is standard. As indicative of the saving possible by the use of low-voltage lamps, the manufacturer points to the following: The 4-cp tungsten lamp has a life of 2000 hours and a specific consumption of 1.25 watts per candle, while the 4-cp, carbon-filament lamp has a life of 1630 hours and a specific consumption of 4.8 watts per candle. Considering that both lamps have an equal life of 1630 hours, the 4-cp tungsten lamp would require 5 watts, or a total of 8150 watt-hours throughout its life, which at a 10-cent rate would bring the cost of energy to 81.5 cents. The carbon-filament lamp would take 20 watts, or a total of 32,600 watt-hours in its life, which at the same rate for electrical energy would bring its cost to $3.26.

The saving in energy cost would amount to $2.445, in favor of the tungsten lamp. The difference in list cost of lamps is 30 cents, in favor of the carbon lamp, or $30 per hundred. Add to this the cost of the transformer and deducting the total from the saving made by the use of the tungsten lamps, the saving in favor of the low-voltage tungsten lamp is still considerable, even ignoring the fact that the lamp has a longer life.

Franklin Small 40-Watt Tungsten Lamp.

The Franklin Electric Manufacturing Company, of Hartford, Conn., has recently made an addition of importance to its regular line of tungsten lamps, namely, a small-bulb, standard Edison base, 40-watt size. This new lamp, like other sizes of tungstens, has a current consumption of from 1 to 1.25 watts per candle, giving three times the amount of light at the same consumption of current when compared with the carbon-filament lamp.

The Franklin tungsten lamp is so constructed that it can be burned in any position owing to the manner in which the fila-



40-WATT TUNGSTEN LAMP.

ments are supported by exceedingly delicate flexible springs.

It will be noted from the accompanying illustration that the filaments are pulled up tightly against the supports with no slack, which allows the lamp to be burned at any angle without any other droop to the filament than is caused by the expansion when the filament is incandescent.

The new 40-watt lamp is made up in the same size bulb as the ordinary 16-cp carbon-filament lamp and is fitted with a small Edison base. This feature will be appreciated by users, as no special fixture or socket will have to be purchased. The new lamp, like all Franklin types, is a five-filament lamp, and as such is somewhat more rugged than a four-filament lamp.

Transformer for Bell-Ringing Circuits.

The Connecticut Telephone & Electric Company, of Meriden, Conn., manufactures a low-potential transformer especially suited for bell circuits and as a substitute for batteries where alternating current is available and applicable. The transformer is shown herewith. It is 6¾ in. in diameter and 3 in. high. The primary is wound for 60-cycle, 110-volt circuits, and three voltages are available from the secondary, namely, 6 volts, 12 volts and 18 volts. While designed primarily to operate tele-

TRANSFORMER FOR BELL-RINGING CIRCUITS.

phone buzzers, annunciators, call-bells, elevator signals, gas-lighters, door-openers, etc., the apparatus can also be employed for a variety of other purposes, such as to supply energy to operate toys, window displays, miniature-lamp outfits and low-potential alternating-current devices. The amount of energy required by bells, etc., is very small, indeed, and the losses in the transformers are said to be also small. A break-down test of 2000 volts is applied to each device.

Watchman's Electric Time Detector.

The watchman's time detector shown herewith and marketed by the Eugene L. Richter Electric Company, of Philadelphia, Pa., possesses the advantage of simplicity. The operating mechanism consists of small magnets in front of which an iron armature, attached to a brass spring, vibrates. The tension on the flat brass spring is adjustable by means of a small set-screw which serves as the fulcrum of the spring acting as a lever. Projecting at right angles to the armature and attached to its

WATCHMAN'S TIME DETECTOR.

end is a needle, which pricks the paper dial used. A Seth Thomas clockwork mechanism is employed to operate the chart, which is divided into five-minute intervals and with the desired number of stations. The detector is built for any number of stations up to 54, the one shown having 10 stations. A magneto is used at each station and one turn of the crank is sufficient to cause the armature of the magnet to oscillate sufficiently to prick a hole in the paper chart and thus to indicate the time the signal from the station was sent. The paper chart also passes through a spring-actuated punch fastened to the side of the box so that if the door of the detector is opened for any reason a hole is punched in the rim of the chart. In this way should the watchman attempt to tamper with the mechanism by opening the door, the act would be detected and the time indicated. Small set-screws are placed in the fork in front of the needles to limit the play of the latter. The device is well put together and can be obtained with a self-winding clock movement if desired or with an indicating clock in addition to the one used to turn the chart.

New Appliances at the Minnesota Convention.

The Central Electric Company exhibited at the Minneapolis convention a new vibrator which will be sold under the name of the "Central" vibrator. This is of the small motor type and can be operated on either an alternating-current or direct-current circuit. Its consumption on direct current is 20 watts.

Another new appliance this company exhibited was the "Tungstometer," which is a small meter, pocket size, adapted to screw in a lamp socket and provided with a receptacle for a lamp or plug. It is calibrated to read in milliamperes and has a slide-rule attachment whereby the watts can be instantly determined if the voltage of the circuit is known.

This company also exhibited a 25-amp solenoid-operated switch controlled from a distance.

A high-tension drop strand protector, which has been developed by the transmission companies in Colorado and is extensively used there, was exhibited. This protector consists of a hook which makes a ball and socket joint. A hook of this kind placed at each end of the span which stretches over the lines which it is desired to protect. Should the line break, the hook will come out at both ends of the span so that the span will fall entirely away from the line in which it is inserted.

The "Central" rotating and oscillating fans were shown. This fan has an attachment which can be set so as to either cause the fan to rotate on its pedestal continuously, or to oscillate between fixed points. When used as a rotating fan attached to the ceiling, it may in some cases take the place of the long-bladed ceiling fans.

The new "Opalux" reflectors which this company is marketing were shown in use in several places in the hotel.

Some iron plates of "silico vanadium" steel, used in the Pittsburgh transformers, were shown to illustrate the new method of insulating the laminations from each other without the use of japan or enamel. A tough coating of gray oxide is formed on these plates, which takes the place of a japan.

The General Electric Company exhibited its new flat heating element which it uses in its new small coffee percolator and some other cooking appliances. This has the new resistance metal used in the shape of a thin ribbon stamped out of a sheet, which is placed flat against the surface to be heated with a thin piece of mica between for insulation. The same metal is used in the wire in the General Electric toaster. It is of high resistance, so that a comparatively short length of wire or other conductor gives the necessary resistance without undue fragility.

The Bryan-Marsh Company rigged up a revolving cluster arrangement whereby a number of tungsten lamps were revolved while burning without breaking, thus showing the toughness of the lamp when hot.

The Westinghouse Electric & Manufacturing Company showed its new form of transformer with coils sawed open to show the construction. Its new 8-in. fans for alternating and direct current were also a prominent feature of the exhibit.

The new Westinghouse-Nernst lamp with improved efficiency and screw burners, which make renewals simple, was shown by the Nernst Lamp Company.

The Pacific Electric Heating Company's "hot point" iron with the automatic plug disconnector, which prevents overheating, was also on exhibition.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There has been a distinct improvement in the condition of trade during the past week, due undoubtedly to the introduction of the tariff bill and the advance of the spring season. A fair business has been doing in nearly all lines, and the total for the week has been better than for the same period last year. Conservative buying is still the rule, and fill-in orders comprise almost the entire business that is being done. The returns from the Easter retail trade are eagerly looked for by the wholesalers and jobbers, but it is believed that the business has been fairly up to the average. Upon the volume of this trade will depend largely the condition of the stocks now in the hands of the country merchants. These are believed to be small. This belief together with the trade so far this spring leads to the optimistic opinion that a general and liberal stocking up will be necessary when the merchants again come into the market. Among the industries there is little evidence of improvement. New orders are not received in plentiful quantities and there are fewer reports of additional workmen being employed. The uncertainty as to the final basis upon which the tariff will be adopted is held responsible for this condition. In the iron and steel plants—except for some structural material and wire—there is very little new business being booked. The large electrical manufacturing concerns report few orders. Those that are received are mostly for small apparatus. Although plans are being made and specifications drawn for quite a large volume of important work, just at the present time all of these orders are held in abeyance. The promoters of large developments are waiting for the certain revival of business before contracting for heavy expenditures. While it is as yet entirely too early to predict with any certainty as to the season's crops, all indications seem to be that the average will be larger than usual and that with average weather we may expect another year of bountiful yields. The railroads continue to report increased earnings and in many cities the building industry shows commendable growth. Collections are as yet only fair, but there are few financial troubles throughout the country. Failures for the week ended March 18, as reported by *Bradstreet's*, were 224, against 254 the week previous, 303 in like week of 1908, 157 in 1907, 170 in 1906 and 204 in 1905.

THE COPPER MARKET.

The price of copper during the past week reached the lowest point touched in the past two years. This depression in price apparently had the effect of bringing into the market a number of domestic consumers who had been holding off, waiting for bargains. In addition, there were a considerable number of foreign inquiries. This activity on the part of the consumers did not, however, result in much actual business. As soon as the producers and selling agencies perceived that there was a disposition to buy, they began to mark up prices. All quotations were at once advanced ⅛ cent. In some instances, the advance was as much as ¼ cent. Even at these figures, the consumers were not permitted to purchase any round lots. Orders were scaled down and the producers declined to contract for future deliveries of any material size. One large consumer, it is said, bid 12⅛, and then 12¼, for a round lot of electrolytic copper, but could not consummate the deal. In some instances, producers refused to sell June and July deliveries at the same figures they were willing to accept for April and May deliveries. For these reasons, the actual business transacted was limited. From a statistical standpoint, there is little change to be noted. There has been little, if any, reduction in the rate of production and there is every evidence that accumulation is increasing. Imports have been rather heavier than at any time during the present year and are running heavier than at the same period last year. There has been a revival of the agitation among the copper traders for the discontinuance of the so-called "copper prices" of the Metal Exchange. As a matter of fact, these prices are largely mythical. They rarely represent the figures at which actual business is being transacted. The live interests in the copper market pay but little attention to the exchange prices and rarely visit its floor. No metal is either bought or sold at the exchange. The action of the copper producers in advancing prices, as soon as there was any indication of buying, is taken to indicate that the powerful interests which have so long been in control of the market are still unwilling to relinquish their grasp. It is the general opinion that the accumulation during March will amount to something like 20,000,000 lb., bringing the stock on hand up to more than 200,000,000 lb. The exports of copper, so far, during the month including March 22, have been 14,006 tons. The quotations on the Metal Exchange March 22, were:

Lake	12⅝	@	12⅞
Electrolytic	12⅜	@	12½
Castings	12⅛	@	12¼

London prices were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	56 2 6	56 7 6
Standard copper, futures	57 0 0	57 5 0
Market	Firm.	Firm.
Sales of spot		400 tons
Sales of futures		2,500 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Castings	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

WESTINGHOUSE PLANTS BUSY.—Reports of the conditions at the various Westinghouse plants in Wilmerding, East Pittsburgh and Swissvale, Pa., continue to indicate a gradual but steady improvement in most of the departments in these factories. At the works of the Westinghouse Electric & Manufacturing Company the number of employees on the shop payroll is growing. The fact that work on the immense $5,000,000 order from the Pennsylvania Railroad Company has at last commenced has given quite an impetus to the operating activity. All the details for the design of the locomotives have been completed. The initial drawings for these will be turned over to the production department about April 1, and the construction will then begin. How many of these engines will be in the first batch has not yet been determined. The Third Avenue Railway Company, of New York City, which placed an order for 200 railway motors some time ago with the company, has supplemented its order with another 100, on which work will be commenced immediately. The Westinghouse Machine Company has received an order from the city of Philadelphia which consists of eleven 300-hp vertical gas engines. These engines will be used in the operation of the high-pressure pumping station which the fire service department of that city began to install about two years ago. At that time the Westinghouse company, after having given a practical demonstration of the superiority of gas engines over steam engines in that class of service, obtained an order for 10 gas engines. The shops of the Westinghouse Air Brake Company, at Wilmerding, Pa., and of the Union Switch & Signal Company, at Swissvale, Pa., are at the present time busier than they have been for some months.

AMERICAN MACHINERY IN MEXICO.—M. I. Sternfield, representative of Braniff & Company, of the City of Mexico, the Mexican agents of the Westinghouse companies, who is at present in Pittsburgh, says that the industrial conditions in the Southern republic are in excellent shape. This is especially true, he reports, in the mining industry. He says that the demand for American electrical apparatus is constantly on the increase. Mr. Sternfield is here to place several orders for locomotives, generators and transformers with the Westinghouse Electric & Manufacturing Company.

LIGHTING EQUIPMENT NEEDED.—The Bureau County Infirmary, of Princeton, Ill., desires a lighting plant capable of supplying from 300 to 500 16-cp lamps. Mr. F. Kramer is superintendent of the Infirmary.

TARIFF ON CARBONS.—The new tariff bill places the duty on carbons for arc lamps at 35 per cent ad valorem, instead of at 90 cents per 100. This is a material reduction and, it is claimed by importers, will lower the price of carbons from $5 to $7 per thousand. It was asserted at the tariff hearings, that the present duty amounted to from 50 to 100 per cent on carbons according to price. This rate on some classes of carbons was in a measure evaded by the importers by bringing in the carbons in 24-inch lengths and cutting them here. This reduced the actual duty to 45 cents per hundred, but added the loss by breakage. The ordinary half-inch carbons for inclosed arc lamps are sold in this country from $22 to $24 per thousand according to the number ordered. It is claimed that these same carbons will be sold, if the new schedule is adopted, at from $15 to $18. An importer in discussing the proposed rate said: "Under the 35 per cent ad valorem clause the importer ought to have an opportunity to get some good-sized orders. Heretofore we have only had the little fellows and the consumers who wanted special high-grade carbons for picture machines or searchlights. For the big orders, the price of domestic carbons was cut to meet our price, the tariff always leaving for the seller a good margin of profit. At 35 per cent I believe we can compete and the consumer will certainly get his carbons cheaper. A carbon that cost $12 abroad would in this country cost $21 plus freight, insurance, breakage loss and our profit. Under the new law the tax on $12 carbons would be $4.20, a reduction in duty of more than 50 per cent. On higher priced carbons the reduction would be much less and on lower grades much more. On flaming-arc carbons, for instance, costing $70 per thousand, the $9 duty was only about 13 per cent. On these the new law will be increased. The low grade molded carbons, for open arc work, we have been unable to import at all owing to the duty being more than 100 per cent; at 35 per cent the importer may be able to enter that field. It is possible, of course, that domestic producers may mark down the price so low that even the proposed duty will make importing unprofitable. The consumer will benefit by the change, in any case."

THE PROPOSED TARIFF ON MICA.—The mica trade expresses itself as being fairly well satisfied with the proposed tariff of 30 per cent ad valorem upon crude mica, and say that it will probably result in a fairer arrangement of duties than the present schedule of 6 cents per pound and 20 per cent ad valorem. Under the present schedule, the cheaper grades of mica were made to pay proportionately a very much higher rate of duty than the expensive grades. In the electrical industries, a great variety of grades of mica is used. On mica which costs not more than 54 cents a pound, the new schedule will be cheaper; on higher priced mica, the new rates will be somewhat higher. One dealer expresses the opinion that a fair average price for the mica used in the electrical industries is 75 cents a pound. If this estimate is correct, the new schedule will not be of advantage to the electrical manufacturers. There is some doubt in the minds of the manufacturers of mica plates and of built up mica, as to whether the proposed duty of 35 per cent ad valorem will furnish sufficient protection for the American industry. At the present time, under a ruling of the customs authorities, this class of mica has been paying a duty of 12 cents per pound and 20 per cent ad valorem.

SMALL CHANGE IN THE ALUMINUM TARIFF.—The new tariff schedule for crude aluminum, if the proposed bill becomes a law, will be 7 cents a pound, a reduction of 1 cent from the rate provided in the Dingley bill. According to a representative of the most important aluminum producer in America, this change will have little effect upon the market price. The present price of aluminum is from 21 to 24 cents a pound, according to purity and the quantity purchased. The change will hardly make an appreciable reduction in these figures. It is not probable that there will be any material lowering of prices until the expiration of the patents under which the Aluminum Company of America is operating. This will occur during the present year.

FLAMING-ARCS FOR CIRCUS LIGHTING.—The immense Ringling circus, which opens its season at Madison Square Garden, New York, to-day, has purchased 36 flaming-arc lamps from the Excello Arc Lamp Company, which, together with 12 lamps purchased from the same company last year, will furnish the illumination for the show tents throughout the season. After leaving New York City the circus will generate its own current, having purchased for this purpose two 40-hp gas engines, belt connected, with 30-kw direct-connected enclosed-type generators, from Fairbanks, Morse & Company. These units will be mounted on wagons, with the switchboard under the seat. The energy used will be 120 volts. The circus has also purchased a 6-hp direct-connected generating unit from the same company for operating the spotlight which is thrown upon important ring features. This outfit is also mounted on a wagon.

LOW-PRESSURE TURBINE MILL AND ELECTRICAL PLANT.—The Bernon Mills-Manville Company, of Georgia, R. I., is to install a 300-kw Westinghouse-Parsons low-pressure steam turbine in connection with its present mill engine. The speed of the turbine will be 3600 r.p.m. The turbine is to run in connection with a 440-volt, 60-cycle alternator, direct-connected. The present mill engine is a 600-hp machine, and the turbine and engine together will develop 90 per cent above the normal rating of the engine alone. The generator will operate a synchronous motor on a line shaft in the mills. The machine was sold through the Boston office of the Westinghouse company.

WESTERN ELECTRIC'S BUSINESS IMPROVING.—The February business of the Western Electric Company showed an improvement of about 15 per cent over that of the same month last year. Orders are now coming in at the rate of about $45,000,000 a year. For the first quarter of the company's fiscal year, which ended Feb. 28, the sales were 30 per cent ahead of the same quarter last year. A large part of the improvement has been in the machinery department, especially in the line of electric light machinery. In the shops manufacturing this class of goods the operatives are working overtime. At present the Western Electric Company has something over 16,000 employees and the number is being gradually increased all the time.

AMERICAN ENGINE COMPANY.—The "Angle" compound engine recently introduced by the American Engine Company, of Bound Brook, N. J., is rapidly receiving recognition, especially on account of the space-saving qualities. One of these engines of 500 hp was recently selected to drive a centrifugal circulating pump connected with the condenser outfit of the Interborough Rapid Transit power house at Fifty-ninth Street and North River. A similar engine was recently purchased by the Government to be installed at the Coast Artillery School at Fort Monroe, Va.

TORONTO CABLE PROPOSALS.—The city of Toronto has issued specifications covering underground cable to the value of about $40,000. Tenders are to be in before the end of March. Further particulars can be obtained from the Electrical Department, City Hall, Toronto.

THE DURAND LAMP WORKS, Vineland, N. J., will be glad to receive trade literature relating to supplies used in the manufacture of incandescent lamps.

Financial Intelligence.

THE WEEK IN WALL STREET.

The Wall Street stock market during the past week has been unusually dull, but prices have continued to be firm. While there is little buying there seems to be just as little selling. There is no pressure being felt on the bear side, and the tendency is rather to advance than to recede. This is taken to mean that Wall Street has accepted the new tariff bill as not being very harmful to any branch of trade. The main reductions, those made in iron and steel products, had been so well discounted that they had no effect upon the industrial stocks. In fact, the United States Steel Corporation has already put its prices upon a basis in keeping with the tariff schedule as proposed in the new bill. If these rates should be finally adopted there would be no necessity for the further lowering of prices on steel products. The extreme stagnation in trading is the direct result of the dullness in all branches of commercial and industrial business. Every one seems to be waiting until the tariff schedules are settled and until there is some revival in trade. Several big bond issues are being discussed, and, while the bond market remains strong, it is hardly as eager as it was a few months ago. There seems to be plenty of money for investment in good mortgage securities, but it is not probable that either a railroad or industrial issue would be as largely oversubscribed at this time as it would have been in December

or January. The preliminary figures of the United States Steel Corporation, while they show an enormous decrease from the previous year, were not unexpected, and the stocks of the company were unchanged when they were given out. Shipments of gold to Europe have apparently had no effect upon the condition of the money market. There seems to be plenty of cash in the banks, and rates remain very easy. Call money on March 22 was quoted at 1½ @ 2 per cent and 90-day paper at 2½ @ 2¾. The quotations in the table are those of the close March 22.

NEW YORK.

	Mar. 15.	Mar. 22.	Shares sold.		Mar. 15.	Mar. 22.	Shares sold.
All.-Ch.	13½*	13⅜*	870	Int.-Met., pfd..	43¾	42¾	19,372
All.-Ch., pfd...	41	43	2,000	Mackay Cos....	73¼*	72⅛*	100
Amal. Cop. ...	66⅝	70½	157,800	MackayCos.,pfd.	71¾*	71*	600
Am. D. T.....	35*	35*	———	Manhattan Elev.	142⅛	142¾*	200
Am. Loc.	50¼	52	3,300	Met. St. Ry....	25*	28*	100
Am. Loc., pfd..	111½*	111½*	———	N.Y. & N.J.Tel.	117*	116	100
Am. Tel. & Cbl.	76½	76½*	———	Steel, com.....	43¾	44¾	363,900
Am. T. & T....	129⅛	130	9,640	Steel. pfd.....	110⅛	110½	15,810
B. R. T.....	70⅝	72⅛	32,690	W. U. T.....	65½	65	1,050
Gen. Elec. ...	153¼	153½*	1,910	West'h., com...	77	79*	1,700
Int.-Met., com..	14¾	14¼	8,977	West'h., pfd....	110*	115	100

PHILADELPHIA.

	Mar. 15.	Mar. 22.	Shares sold.		Mar. 15.	Mar. 22.	Shares sold.
Am. Rys.	46*	45¾	———	Phila. Elec. ...	11⅝	11⅝	———
Elec. Co. of A.	11⅞	12¼	———	Phila. R. T....	27½	27⅞	———
Elec. Stor. B'ty	46½	46⅜	———	Phila. Traction.	91	92¼	———
E. S. B'ty, pfd.	49*	49*	———	Union Traction.	53½	53¾	———

CHICAGO.

	Mar. 15.	Mar. 22.	Shares sold.		Mar. 15.	Mar. 22.	Shares sold.
Chi. City Ry...	187*	187*	———	Chi. Tel. Co....	132	133	———
Chi. Rys., Ser.1.	111*	110*	———	Met. Elev., com.	19*	19*	———
Chi. Rys., Ser.2.	48½	40¼*	———	Nat'nal Carbon.	85½	85½*	———
Com. Edison...	111¾	111	———	Nat. Carb., pfd.	119	119*	———
Chi. Subways...	25¼*	26	———				

BOSTON.

	Mar. 15.	Mar. 22.	Shares sold.		Mar. 15.	Mar. 22.	Shares sold.
Am. Tel. & Tel.	129⅛	130	———	Mex. Tel.	2½	2½*	———
Cum. Tel.	127⅛*	127⅛*	———	Mex. Tel., pfd.	5*	5*	———
Edison El. Ill..	253½	254	———	N. E. Tel.	135	134½	———
Gen. Elec.	154	154	———	W. Tel. & Tel..	7*	7*	———
Mass. Elec. Ry.	15*	14¾*	———	W. T. & T., pfd.	77½*	77¾	———
Mass. E. R., pfd	70½	71	———				

*Last price quoted.
Shares sold are for week March 15 to March 20.

DIVIDENDS.

American Cities Railway & Light Company, preferred, quarterly, 1½ per cent, payable April 1.

Bell Telephone Company of Canada, quarterly, 2 per cent, payable April 15.

Butte (Mont.) Electric & Power Company, preferred, quarterly, 1¼ per cent, payable May 1; common, quarterly, 1½ per cent, payable April 1.

Columbus (Ohio) Railway & Light Company, ½ per cent, payable April 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable April 1.

Electric Boat Company, preferred, quarterly, 2 per cent, payable April 1.

Evansville (Ind.) Light Company, preferred, quarterly, 1½ per cent, payable April 1.

Germantown Passenger Railway, Philadelphia, quarterly, 2.62¼ per cent, payable April 6.

International Nickel Company, Bayonne, N. J., preferred, quarterly, 1½ per cent, payable May 1.

Michigan Light Company, preferred, quarterly, 1½ per cent, common, quarterly, 1 per cent, both payable April 1.

Peoria (Ill.) Light Company, preferred, quarterly, 1½ per cent, payable April 1.

Ridge Avenue Passenger Railway, Philadelphia, quarterly, 6 per cent, payable April 1.

Springfield (Mo.) Railway & Light Company, quarterly, 1 per cent, payable April 1.

Tri-City Railway & Light Company, Davenport, Ia., preferred, quarterly, 1½ per cent, payable April 1.

Twin City Rapid Transit Company, Minneapolis, preferred, quarterly, 1¾ per cent, payable April 1.

Union Switch & Signal Company, preferred and common, quarterly, 3 per cent, payable April 10.

United Railways Company, St. Louis, preferred, quarterly, 1¼ per cent, payable April 10.

Washington Water Power Company, Spokane, Wash., quarterly, 1¾ per cent, payable April 1.

Wilkes-Barre (Pa.) Gas & Electric Company, quarterly, 1 per cent, payable April 1.

TO SELL METROPOLITAN STREET RAILWAY.—A decree in the United States Circuit Court in the foreclosure suit brought by the Guaranty Trust Company of New York against the Metropolitan Street Railway Company was entered last week directing the company to pay to the clerk of the court, within 20 days after the service of the notice, the sum of $13,589,270, representing the amount of first mortgage bonds held by the company together with the interest. In default of this payment, the special master, William L. Turner, is ordered to sell the property of the railway company at auction. The date fixed for the sale is June 1. This sale will include all the property belonging to the Metropolitan Street Railway Company except the Belt Line, the Twenty-eighth and Twenty-ninth Street and Fulton Ferry lines. If the proceeds of this sale are not sufficient to meet the debts of the trust company, the purchaser will be required to make up the deficiency. The trust company holds $12,500,000 of these bonds, and the interest has been in default for 18 months. In addition, the purchaser will have to pay into court, in cash, such a sum as is deemed sufficient for the redemption of the receivers' certificates, amounting to $3,500,000, and to pay the claims of several creditors who are designated by the court. No definite plan has yet been devised for the reorganization of the Metropolitan Street Railway system, but it is promised that before the date of the sale the joint reorganization committee will be ready to offer a definite scheme for rehabilitation that will be just to all classes of security holders.

WESTERN UNION BOND ISSUE CLOSED.—The Western Union Telegraph Company has decided to close its issue of $25,000,000, 4 per cent, bonds which was authorized in the fall of 1906 and to conclude its mortgage at its present amount. Of these bonds only $10,000,000 have been issued. These were subscribed for by the stockholders at 87½. They are secured by a deposit of New York Telephone Stock to the amount of $9,733,100, the bonds being convertible into stock at par between Jan. 1, 1909, and Jan. 2, 1919. The Telephone stock deposited under this bond issue is worth more than $200 per share and pays about 15 per cent per annum. The directors of the Western Union have decided that the condition of the company at present is such that a further issue of bonds is not necessary.

OTIS ELEVATOR COMPANY.—The annual report of the Otis Elevator Company, for the year 1908, shows net earnings, after a liberal charge for depreciation, of $832,772, which is a decrease of $165,332, or barely 20 per cent from the previous year. This is considered a very favorable statement considering the condition of business during the year. The profits for the year are equal to a trifle more than 7 per cent on the $6,375,300 common stock, after having paid the regular 6 per cent dividend on the preferred shares. The company also made a material reduction in its notes and bills payable.

MICHIGAN STATE TELEPHONE COMPANY.—The report of the Michigan State Telephone Company, for the year 1908, shows increases of more than 10 per cent in the gross and 18 per cent in the net earnings in spite of the business depression. The net earnings applicable for dividends were $911,429, and the company is paying 6 per cent on its preferred and 4 per cent on its common stock. N. W. Harris, chairman of the board of directors, says that the year has been the most satisfactory in the history of the company, and that its financial position is stronger than it has ever been before.

MISSOURI & KANSAS TELEPHONE COMPANY.—The report of the Missouri & Kansas Telephone Company for the year 1908 shows gross earnings of $2,653,148, as compared with $2,428,893 for the previous year. The net earnings were $491,280, as against $688,822, leaving a deficit after the payment of fixed charges of $420. The company now has a total deficit of $260,069, which has been charged to reserve for maintenance. The company is the Bell subsidiary operating in Missouri and Kansas. The general depressed condition of trade is held responsible for the decrease in earnings.

CHICAGO RAILWAYS COMPANY.—The preliminary figures of the Chicago Railways Company for its fiscal year, which ended Jan. 31, 1909—January being partly estimated—show gross earnings from all sources of $10,994,306, an increase of $434,234, or a little more than 4 per cent over the earnings under the Union Traction management the year previous. The net earnings, after making all deductions required under the ordinance, are $1,558,367, a decrease of $43,465 from the previous year. The city's portion is $857,102 and the company's $701,265.

CHICAGO CITY RAILWAY COMPANY'S ANNUAL REPORT.—President T. E. Mitten, of the Chicago City Railway Company, submitted his annual report to the stockholders on March 16. The report covers a period of 13 months, in order to bring the fiscal year to Jan. 31, as prescribed by the ordinance under which the company is now operating. The report shows that 54 miles of track have been reconstructed during the 13 months ended Jan. 31, 1909. This leaves but 13½ miles to be reconstructed during the present year. Of the company's cars, 452 are of the pay-as-you-enter type and there are four car houses having a total housing capacity of about 1100 cars. Mr. Mitten refers to an "advantageous agreement" by which his company will purchase of the Commonwealth Edison Company for a period of at least 10 years, from June 1, 1908, all of the electrical energy used in the operation and maintenance of its railway system. A new substation has been built during the year, and new rotary converters are now being installed therein. There are now four such substations, with a total rating of 36,000 kw. A large storage battery has been added to the Chicago City Railway Company's equipment in the Plymouth Place substation of the Commonwealth Edison Company. The new underground conduit system for the distribution of power is practically completed, and the installation of cables in it is well under way. For the 13-month period the number of paying passengers carried was 180,243,173, and the total number of fare and transfer passengers was 292,220,866. The company owns 252 miles of single track. Its total receipts for the period mentioned were $9,195,782. The net earnings are given as $1,026,288, and the city's 55 per cent of this under the settlement ordinance is $564,458. To the company's proportion of the net earnings are added interest on capital invested and "other income," including contractors' profit, brokerage, etc., making the total $2,849,483. After deducting bond interest there remained $1,620,000 paid in dividends and $379,743 carried to surplus. The report shows that, although the number of paying passengers was increased about 3 per cent during the year, the net earnings were less, owing to the interest on the additional capital invested in the extensive rehabilitation work. This interest on capital is figured in the deductions from the gross earnings before the net earnings are arrived at.

NORTHERN OHIO TRACTION COMPANY STOCK LISTED.—The New York Stock Exchange has admitted to its list the $9,000,000 capital stock of the Northern Ohio Traction & Light Company, of Akron, Ohio. As the Exchange requires accurate and detailed information of a corporation's financial condition to be made at regular periods, the listing of the stock of a public service corporation unquestionably strengthens its position as an investment proposition. The company was incorporated in 1902 as successor to the Northern Ohio Traction Company. It has a total of 214.05 miles of track and has perpetual franchises to furnish light and power in Akron and Barberton. The net earnings for 1908 were $804,049 and the surplus for the year was $143,366.

PACIFIC TELEPHONE & TELEGRAPH BONDS.—It is announced that J. P. Morgan & Company and some other New York bankers will shortly offer to the public a portion of the 5 per cent collateral trust bonds recently underwritten for the Pacific Telephone & Telegraph Company. The total amount of bonds taken in this deal was $16,300,000. About $6,000,000 of this amount was the unsold portion of the $10,000,000 issue which was underwritten in 1907 by a syndicate headed by N. W. Harris & Company. Owing to the panic and depressed condition of business, the syndicate was unable to dispose of its holdings.

CHICAGO SUBWAY PLANS.—The complete report upon a subway system for Chicago, the preparation of which has been occupying the time and energy of scores of engineers and accountants for the past seven months, was made public last week. The cost for collecting the data for the report was $75,000 and it is considered that the work is one of the most complete ever got out by a municipality. An elaborate plan for subways is outlined, the basis for which will be a line encircling the business section of the city and extending to the western suburbs. This portion of the work alone, which probably will be the first undertaken, will cost at least $50,000,000.

OSWEGO COUNTY LIGHT & POWER COMPANY.—The Oswego County Light & Power Company, which is developing a hydro-electric plant at Salmon River Falls, N. Y., has petitioned the Public Service Commission of the Second District of New York for authority to increase its capital stock from $1,000,000 to $1,100,000 and to issue $2,500,000 in bonds. The reservoir, to be formed from the construction of the dam at the falls, will cover over 7000 acres and will extend easterly to Redfield, N. Y. The engineers of the company expect to develop at least 15,000 hp.

FRANCHISE REPEAL STOPPED BY COURT.—The United States District Court at Louisville, Ky., has granted a temporary injunction restraining the city from putting into effect an ordinance recently adopted by the Municipal Council, revoking the local franchise of the Cumberland Telephone & Telegraph Company. The order is made returnable March 29. For a number of months the city has been endeavoring to force a reduction in telephone rates, which the Cumberland company has so far successfully resisted.

LOUISVILLE RAILWAY COMPANY BONDS SOLD.—The Fidelity Trust Company, of Louisville, Ky., was the successful bidder for the $1,000,000 issue of 4½ per cent second mortgage gold bonds recently offered for sale by the Louisville Railway Company. The price paid was 97¾ for the entire lot. These bonds were issued to pay for the Louisville & Eastern Railroad, a suburban line which was recently taken over.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
February, 1909	$2,264,309	$167,381	$2,096,928	$780,834	$1,316,094
February, 1908	2,102,759	181,029	1,921,730	647,546	1,274,184
Bell Telephone Company of Missouri:					
Year 1908	2,009,355	1,346,960	662,375	.....	.....
Year 1907	1,933,429	1,392,429	540,501	.....	.....
Birmingham (Ala.) Railway, Light & Power Company:					
February, 1909	117,453	108,447	69,006	44,785	24,220
February, 1908	167,341	109,848	57,493	43,524	13,969
Chicago City Railway Company:					
13 months ended Jan. 31, 1909	9,195,782	8,169,494	1,026,288	.....	379,743
11 months ended Dec. 31 1907	7,562,693	6,410,272	1,152,421	.....	701,558
Electric Storage Battery Company:					
Year 1908	845,705	315,180	530,525	.....	.....
Year 1907	1,075,220	387,021	688,205	.....	.....
Knoxville(Tenn.) Railway & Light Company:					
February, 1909	43,867	22,601	21,265	11,483	9,782
February, 1908	42,990	23,309	19,681	11,398	9,282
London (Ont.) Street Railway Company:					
Year 1908	235,032	167,567	67,466	28,455	39,011
Year 1907	232,377	168,025	64,352	27,229	37,123
Memphis Street Railway Company:					
February, 1909	118,091	76,788	41,303	35,250	6,052
February, 1908	112,646	75,197	37,448	34,450	2,997
Missouri & Kansas Telephone Company:					
Year 1908	2,653,148	2,161,868	491,280	761,607	*270,327
Year 1907	2,428,893	1,710,071	688,822	688,402	420
National Light, Heat & Power Company:					
Year 1908	731,582	412,225	319,327	151,624	167,703
Year 1907	596,528	357,935	238,593	120,206	118,387
Northern Ohio Traction & Light Company:					
February, 1909	136,504	80,542	55,963	43,731	12,232
February, 1908	119,301	78,466	40,835	43,775	*2,920
United Railways of St. Louis:					
February, 1909	808,160	531,778	276,382	234,917	41,465
February, 1908	775,400	519,540	255,914	233,418	22,496

*Deficit.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—Preparations are being made by the Aldrich Power Company to erect its transmission lines in Birmingham. The company is now constructing its line from the power plant at North Birmingham to the city limits. It is said that a site has been purchased on Village Creek, where a new plant will be erected at a cost of $500,000.

TALLADEGA, ALA.—Surveys are being made of Choccolocco Creek at Jackson's Shoals for the Alabama Power Development Company in connection with its proposed power plant, which will supply electricity for lamps and motors in Gadsden, Anniston, Talladega and other points.

PHOENIX, ARIZ.—It is said that arrangements are being made to organize a company to construct an electric street car system in Phoenix to connect with a railway, which will be known as the Suburban Railway. It is expected that gasoline-electric cars will be used. J. W. Dorris, George M. Halm, Homer B. King, F. J. Bennitt and B. A. Fowler are interested in the project.

RECTOR, ARK.—The Rector Co-operative Telephone Company has filed an amendment to its charter increasing its capital stock from $5,000 to $10,000.

AGNEW, CAL.—Bids will be received by the Board of Managers of the Agnew State Hospital, at 7 West Santa Clara Street, San José, Cal., until April 7 for constructing and installation of a complete conduit heating and lighting system. Bids will be received for the complete work as per plans and specifications and for various parts as indicated on the form of proposal. Plans and specifications may be seen at the above office, at Agnew State Hospital, Agnew, Cal., and at the State Department of Engineering, Sacramento, Cal. Plans and specifications may be obtained by application to the State Department upon a deposit of $10, which will be returned when plans are returned. Proposals should be addressed to L. M. Simonsen, secretary of board of managers.

BISHOP, CAL.—The Casa Diablo Mining Company is planning to enlarge its power plant and will install a 250-kw generator to furnish electricity for new machinery in its stamp mill. H. E. McNeil is manager.

HOLLISTER, CAL.—The plant and holdings of the Hollister Light & Power Company have been purchased by the Great Western Power Company. William Palmtag is president of the Hollister Light & Power Company.

RED BLUFF, CAL.—Notice has been filed by C. E. Burris of appropriation of 10,000 cu. in. of water in Mill Creek to be diverted from the bank and carried by a flume 7 ft. wide and 4 ft. deep to a point where an electric power plant is to be erected.

RED BLUFF, CAL.—The Board of Supervisors has granted a 50-year franchise to the Sierra Electric Company to erect transmission lines for the distribution of electricity for lamps, motors and other purposes in Red Bluff. Frank C. Wilson is secretary.

SAN FRANCISCO, CAL.—The Forest Service has allowed the Nevada-California Company a right to run a second transmission line through Silver Canyon in the White Mountains. The company already operates a 113-mile line to the Tonapah and Goldfield district.

SANTA ROSA, CAL.—The City Council has granted the Northwestern Pacific Railroad Company a franchise to construct a street railway in this city.

SUISUN CITY, CAL.—The Board of Supervisors is asking for bids for a franchise for an electric railway to connect Vallejo, Benicia and White Sulphur Springs, for which preliminary surveys have been made. Randle, Wright & Trowbridge, of Oakland, Cal., have applied to the Board of Supervisors for such a franchise.

WHEATLAND, CAL.—Arrangements are being made to install a new pump and motor in the municipal water works plant.

YREKA, CAL.—The Sisiyou Electric Power Company has filed a notice of appropriation of 450,000 in. measured under a 4-in. pressure of the Klamath River, to be taken at two points about half-mile distant from the present power plant on Fall Creek. The company will commence work this spring on the construction of a new power plant to be located on the Klamath River at Ward's Canyon, which will have an output of about 60,000 hp and will require three years to build. The company's present plant at Fall Creek has an output of 6000 hp. Jesse W. Churchill is president of the company.

BOULDER, COL.—It is reported that the Rocky Mountain Hydro-Electric Company is planning to erect a new power plant, at a cost of $1,000,000.

NEW LONDON, CONN.—The Groton & Stonington Street Railway Company is making surveys for a proposed extension of its railway from Mystic to Old Mystic, a distance of three miles.

TORRINGTON, CONN.—The State Legislature has passed the bill authorizing the Borough of Torrington to issue $150,000 in bonds to pay indebtedness of the borough and to provide for extension of sewer, street lighting and fire alarm systems.

WASHINGTON, D. C.—Congress has passed the bill appropriating the sum of $100,000 for centralizing the power, heating and lighting plant, remodeling the electric layout, and substituting electrically-driven for steam-driven machinery, and for other improvements to electric light and power system at the Government Hospital for Insane, Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the Bureau of Docks and Yards, Navy Department, Washington, D. C., until April 17 for furnishing and installing one electric capstan at the navy yard, Philadelphia, Pa., and three at the navy yard, Mare Island, Cal. Plans and specifications can be obtained on application to the bureau of the commandant of the navy yards named. R. C. Holliday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the office of the General Supply Committee, Room 176, Treasury Department, Washington, D. C., until April 12 for furnishing general supplies ,including electrical, engineering supplies, etc., for executive departments and independent establishments and for the District of Columbia for the fiscal year ending June 30, 1910. Blank forms with specifications to bidders will be furnished on application to the above office. W. W. Ludlow is chairman of the General Supply Committee.

ATLANTA, GA.—The Piedmont Power Company has applied to the State Railroad Commission for permission to issue $5,000,000 in bonds and $3,000,000 in capital stock. The company proposes to develop water power on the Tugalo River, below Tallulah Falls, and has applied for a franchise to distribute electricity in Atlanta.

ELBERTON, GA.—The construction of an electric railway from Iva, S. C., to Elberton, via Ruckersville, Ga., is reported to be under consideration. Guy G. Rucker, of Ruckersville, Ga., is interested in the project.

LAGRANGE, GA.—Contracts have been awarded by the Unity Cotton Mills for the construction of buildings for Unity Mill No. 2. The factory will be operated by electricity and will require about 500 hp. Fuller E. Callaway is treasurer.

LEWISTON, IDAHO.—The Nes Perce & Idaho Electric Railway has been purchased by W. A. Leet, president, and C. A. Taylor, manager, of the Willamette Valley Oil Company, of Salem. Ore. Extensions will be made.

ST. ANTHONY, IDAHO.—Surveys are being made by the Idaho Falls Traction Company, of Idaho Falls, for its proposed railway from Idaho Falls to St. Anthony.

SANDPOINT, IDAHO.—It is reported that a deal has been consummated by Byllesby & Co., of Chicago, Ill., whereby the plants and holdings of Pend Oreille Electric Light Company, of Sandpoint; the Newport Light & Power Company, of Newport, Wash.; the Flathead Valley Water Power Company, of Kalispell, Mont., together with a plant at Whitefish, Mont., and several other plants, will be consolidated. The new company will be known as the Northern Idaho & Montana Electric Light Company. The holdings acquired include numerous riparian and water rights on Lightning Creek and along Moyie and Clark's rivers, which will be developed and utilized to generate electricity. A bond issue of $10,000,000 has been authorized. The company contemplates extensive improvements and extensions to all of the plants.

TWIN FALLS, IDAHO.—Plans are being made to organize a company to construct an electric railway in Twin Falls. Application will soon be made to the City Council for a franchise. I. B. Perrine is interested in the enterprise.

CHICAGO, ILL.—Bids will be received by William Carroll, city electrician, at his office, Room 403, 76 Fifth Avenue, until March 31 for furnishing the Department of Electricity with three kva. transformers in accordance with specifications on file at the above office. Proposals must be made out on blanks furnished by the city electrician.

ELGIN, ILL.—Plans are being considered by the officials of the Aurora, Elgin & Chicago Railroad Company and the City Council for replacing the present street lamps with new arc lamps.

ELMWOOD, ILL.—The Elmwood Electric Light Company has changed its system to single-phase, 60 cycles, and will establish a 24-hour service. It is in the market for motors and other appliances. E. L. Brown is manager.

HUNTLEY, ILL.—The Village Board is considering the question of installing electric street lamps, the energy to be furnished by the Elgin & Belvidere Electric Company, of which W. L. Arnold, of Chicago, is general manager.

ROCK ISLAND, ILL.—Congress has passed the bill appropriating the sum of $12,500 for operation and maintenance of power plant at the Rock Island Arsenal.

WARREN, ILL.—W. E. Bucher, of Martintown, Wis., has been making investigations in this village with a view of furnishing electricity in Warren for lamps and motors. Mr. Bucher proposes to raise his dam at Martintown, which now furnishes 700 hp, to provide sufficient power to operate a plant of sufficient output to supply electricity in Winslow.

Lena, Nora and Warren. As yet no franchise has been granted, but it is understood that one will be given on very reasonable terms.

JASONVILLE, IND.—The streets of the village have been in darkness for the past three weeks owing to the plant of the Jasonville Electric Company shutting down for repairs. H. L. Hyatt, principal stockholder of the company, has made a proposition to lease the plant to the town for a term of one year, charging eight per cent on the total investment, which would amount to about $1700 per year. A committee was appointed to look into the matter and report at another meeting, which will be called to take action on the same. The town has been paying the company $1800 per year for the street lighting service.

KNIGHTSTOWN, IND.—An examination of the municipal electric light plant is being made with a view of improving the plant and adding new equipment.

PRINCETON, IND.—It is reported that the Weber grist mill has been leased by John Graves, of Paris, Ill. It is proposed to operate the mill by electrical power and also to furnish electricity to light the streets of Patoka, Ind.

RUSHVILLE, IND.—Plans are being considered for increasing the output of the municipal electric light plant. It is proposed to install an additional unit and furnish a day power service. The cost of the work is estimated at $8,000.

BELLEVUE, IA.—The City Council has awarded contracts for additional equipment for the municipal electric light plant as follows: For generator, to the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and for gas-producer engine, to the Foos Gas Engine Company, of Springfield, Ohio. The improvements will involve an expenditure of $6116, and, when completed, a 24-hour service will be established for both lamps and motors.

CEDAR RAPIDS, IA.—Extensive improvements are contemplated by the Cedar Rapids & Marion Telephone Company to its system in Grand Rapids, Marion, Mt. Vernon and Kenwood Park, which will involve an expenditure of about $26,000. Not less than 60,000 ft. of cable will be used.

MODALE, IA.—The Interstate Telephone Company has increased its capital stock from $50,000 to $100,000. W. A. Smith is president.

WEBSTER CITY, IA.—Three new telephone companies have been organized in Webster City, all of which are building telephone lines into this city to connect with the independent company. One of the companies is located in Independence and Rose Grove townships and the other two in Blairsburg and Cass.

FORT LEAVENWORTH, KAN.—Bids will be received by Captain William D. Davis, quartermaster, until April 2, for electric wiring and furnishing and installing electric lighting fixtures, transformer, watt meter and making service connections to the cavalry drill hall. Plans and specifications may be seen at the above office and at the offices of the chief quartermasters, at Omaha, Neb., and Denver, Col., and Master Builders' Exchange, Kansas City, Mo.

TURNER, KAN.—A company has been organized by several business men of Turner to construct an electric railway from Turner to Argentine, a distance of 1¾ miles, to connect with the Metropolitan Street Railway Company's system at Argentine. The name of the company and capital stock have not yet been decided upon. The officers of the company are: J. J. Swingley, chairman; F. L. Strickland, secretary, and L. P. Hewitt, treasurer.

BELLEVUE, KY.—The City Council has passed an ordinance providing for the sale of an electric light franchise. The contract provides that, if any city or district in Campbell County shall secure cheaper rates than the contract price, rates to local consumers shall be reduced accordingly. It is expected that the Union Light, Heat & Power Company, which has the present contract will be the only bidder. The contract is to take effect Sept. 1.

LEXINGTON, KY.—The City Council has authorized the Mayor to enter into a contract with the Lexington Railway Company to furnish electricity for street lighting. Under the contract the company is to furnish arc lamps at the rate of $74 per lamp per year, which is a reduction of $4.50 per lamp per year, and to furnish 16-cp incandescent lamps on the viaduct at $8.50 each per year. The price for electricity for residential lighting is to be reduced from 20 to 18 cents per kw-hour, with a discount of 20 per cent if paid within the time limit. A reduction was also made in the charge for electricity for lamps in the city buildings.

LOUISVILLE, KY.—The City Council has granted P. Campbell, manager of the Fifth Avenue Hotel, a franchise to supply electricity for lamps and heat on the block on which the hotel is located.

ABBEVILLE, LA.—The managers of the municipal electric light plant have decided to install tungsten lamps for street lighting, commercial and residential lighting.

PLAQUEMINE, LA.—The power house of the Plaquemine Electric Light & Power Company is reported to have been destroyed by fire.

ALFRED, MAINE.—The citizens have voted to enter into a contract with the Alfred Embroidery Company to furnish electricity for 35 incandescent street lamps at a cost not exceeding $500 per year.

BINGHAM, MAINE.—The citizens have voted to authorize the Selectmen to enter into a contract with the Bingham Electrical Company to light the streets of the town for one year.

BINGHAM, MAINE.—The Bingham & Dead River Railway Company has applied to the State Legislature for a charter to operate an electric railway in the Dead River region. E. E. Richards, of Farmington, and Cyrus W. Blanchard, of Wilton, Maine, represented the company.

BOWDOINHAM, MAINE.—It is reported that the Bowdoinham Reduction Company, recently organized, contemplates installing an electric power plant and may furnish electricity for lighting the town.

KENNEBUNK, MAINE.—The citizens have voted to install an auxiliary steam plant in the municipal electric light station, for which $7,000 has been appropriated. It was also voted to extend the electric light system up through Alewive at a cost of $2,500. A committee, consisting of Frank W. Bonser, Edwin I. Littlefield and Philbert Raino, has been appointed to have entire charge of the electric light department.

HAGERSTOWN, MD.—Plans are being considered to double the output of the municipal electric light plant. J. O. Beard, general manager, has been instructed to ascertain the cost of the work. It is proposed to install a 1000-hp engine and a 750-kw generator, at an estimated cost of $20,000.

BOSTON, MASS.—Sealed proposals will be received at the U. S. Engineer Office, Boston, Mass., until April 26 for boilers, engines, generators, electrical cable and switchboards. Information and blank forms may be obtained on application to the U. S. Engineer offices at Boston, Mass., Seattle, Wash., Portland, Ore., and San Francisco, Cal.

BROOKLINE, MASS.—The committee appointed by the Selectmen to investigate the question of establishing a municipal electric light plant have decided against the plan and recommend that the town continue to purchase electricity from the Boston Consolidated Gas Company under the new schedule submitted to the town. The rates under the new schedule offered by the company, to take effect July 1, are as follows: Flat rate, 14 cents per kw-hour; maximum demand, primary 16 cents per kw-hour, secondary 7½ cents, tertiary 5 cents, arc lamps $110 per lamp per year; and rates to go into effect July 1, 1910, are, respectively, 16 cents, 18 cents, 7½ cents and $110. The prices at present are, respectively, 16 cents, 18 cents, 8 cents, 5 cents and $124.

HOLYOKE, MASS.—The bill to amend the charter of the Holyoke Water Power Company to enable the company to sell electricity to its tenants has been passed by the Legislature. Plans are being prepared by the company for erecting new buildings in the near future.

OLDTOWN, MASS.—The citizens have voted to establish a street lighting system in Oldtown, electricity for which will be furnished by the municipal electric light plant of North Attleboro. Work on construction of the transmission lines will begin about April 1. William Plattner is manager of the electric light plant.

WAKEFIELD, MASS.—The committee appointed to make investigations in regard to the municipal electric light plant has submitted its report, in which it advises the town to abandon the plant and to purchase electricity to operate the municipal system for a term of five years. The Malden Electric Company has submitted a proposition to the committee for furnishing electrical energy as follows: Under a five-year contract the company agrees to furnish a minimum of 200 kw at the rate of 3¼ cents per kw-hour at the switchboard of the municipal plant.

BAY CITY, MICH.—The Chippewa River Power Company has applied to the City Council for a franchise to supply electricity for lamps and motors in Bay City. The company has acquired property along the Chippewa River, in Chippewa and Midland Counties, and proposes to construct a series of dams for the development of a hydro-electric plant to generate electricity for lamps and motors. J. L. Hudson, of Detroit, Mich., is president; Wilbur F. Davidson, of Port Huron, Mich., vice-president, and Frederick B. Brown, of Port Huron, treasurer.

GALESBURG, MICH.—The Independent Co-operative Telephone Company is making arrangements for the construction of a local exchange in Galesburg and for the erection of trunk lines to Augusta, Climax, Scotts, Howlenburg, Comstock and Kalamazoo.

GRAND RAPIDS, MICH.—The city is considering the question of erecting a hydro-electric power plant. L. W. Anderson is city engineer and Prof. Lyman E. Cooley, consulting engineer.

WAYNE, MICH.—The capital stock of the People's Telephone Company has been increased from $6,000 to $20,000.

DULUTH, MINN.—The Duluth-Edison Electric Company, it is said, will place its wires underground as soon as the frost is out of the ground.

FERGUS FALLS, MINN.—At an election to be held April 6 the citizens will vote on the proposition to issue $5,000 in bonds, the proceeds to be used for extensions to the municipal electric light plant.

FERGUS FALLS, MINN.—The plant of the Otter Tail Power Company is nearly completed. The company is now furnishing electricity to a few concerns in Fergus Falls and will soon be ready to furnish electrical service in Wahpeton, N. D., and also contemplates extending its transmission lines to Fargo, N. D.

MINNEAPOLIS, MINN.—A company has been organized to construct a railway from Minneapolis to Anoka, for which the sum of $75,000 has been pledged. It is expected that gasoline-electric cars will be operated. C. A. Nelson is chairman.

WEGGELAND, MINN.—A company has been organized in Weggeland to construct a telephone line from Maine to Weggeland and to Fergus Falls. William Schmidt is president.

MARYSVILLE, MO.—The Hanamo Telephone Company is making

preparations to construct an underground conduit system in the business section of the city.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company has decided to increase the output of its plant by 2500 kw and will install additional equipment at a cost of $100,000. John Van Brunt is general manager.

ST. JOSEPH, MO.—The Home Telephone Company has filed with the county recorder a mortgage of $2,000,000 on its plant to secure an issue of a like amount in bonds. The company proposes to erect a new plant in St. Joseph at a cost of $750,000.

ST. LOUIS, MO.—The St. Louis, Creve Coeur Lake & Western Railway Company, which proposes to construct a street car line on Etzel Avenue and the Olive Street road to the upper end of Creve Coeur Lake, will, before transmission lines are erected, experiment a storage battery car and a gasoline-electric car. The railway will be double-tracked and will cost, approximately, $750,000.

BILLINGS, MONT.—The Madison River Power Company is making arrangements to construct a high-tension transmission line from Billings to Livingstone, which will eventually be extended to Great Falls.

LEWISTON, MONT.—Samuel W. Gebo, owner of the Spring Creek coal mines, is planning to establish an electric and gas plant, and has applied to the City Council for a franchise. The matter will be submitted to the people at a special election.

MOORE, MONT.—George I. Fogle, it is reported, contemplates the construction of an electric light and power plant.

PAWNEE CITY, NEB.—Plans are being considered to install a 30-kw, alternating-current, 1100-volt, 60-cycle generator in the municipal electric light and water-works plant. I. E. Foose is superintendent.

GOLDFIELD, NEV.—The Nevada-California Power Company is planning the erection of a new transmission line, about 314 miles in length. The new part of the line will extend from Tonapah to Ely and will furnish electricity for lamps and motors to the camps between the two cities. Electricity transmitted to Ely will be utilized to operate the hoists of the large copper mines and machinery in the smelters. The power plant is located at Bishop, Cal., and already furnishes electricity in Tonapah and other important camps.

ROUND MOUNTAIN, NEV.—L. D. Gordan, of Round Mountain camp, states that preparations are being made by his company to increase the output of its mill by 20 per cent and to equip the machinery to be operated by electricity. A compressor plant will also be installed.

WABUSKA, NEV.—Plans are being considered by the St. Ives Leasing Company for the construction of a mill and power plant on East Walker River, about 30 miles from Wabuska, where it is estimated that 300 hp can be developed.

DERRY, N. H.—A committee, consisting of William T. Morse, Frank N. Young, Cassius S. Campbell, Amos L. Proctor and Lando B. Hardy, has been appointed to investigate the question of installing an electric light plant in connection with the municipal water-works system to furnish electricity for street lamps.

EPPING, N. H.—At a recent town meeting the Selectmen were authorized to enter into a contract with the Newmarket Electric Light Company to furnish electricity to light the streets and town hall for a period of five years, with the privilege of renewing it for an additional five years.

HOOKSET, N. H.—The Selectmen have been authorized to enter into a contract with the Manchester Traction, Light & Power Company to light the streets of the village at a cost of about $1,300 per year.

MILTON MILLS, N. H.—The citizens have voted to accept the proposition of the proprietors of the Townsend's Mills to light the town with electricity furnished from the plant at the mills.

PLAISTOW, N. H.—The citizens are considering the question of lighting the streets of the town by electricity. It is said that the Haverhill Electric Company, of Haverhill, Mass., is ready to extend its transmission lines to Plaistow Centre and Westville to furnish electricity in both villages.

WINCHESTER, N. H.—The electric light committee has been authorized to enter into a contract with some electrical company to furnish electricity to light the streets of the town. It is proposed to install 75 street lamps at a cost not to exceed $1,350 per year.

ASBURY PARK, N. J.—Engineer Everett Hill has submitted a report to the Council recommending the adoption of electricity as motive power for the sewage disposal plant, the adoption of alternating current for the pumping station and the installation of a duplicate generating plant in the water-works station to furnish electricity for both the sewage pumping station and the Deal Lake pumping station, and the consummation of a contract with the Atlantic Coast Electric Light Company for service in case of break-down to the sewage disposal station. The cost of the plant is estimated at $6000.

LAKEWOOD, N. J.—Application has been made to the Secretary of State by Charles H. Le Compte and James H. Butcher, of Lakewood; R. A. Clark, Joseph W. Johnson, A. C. S. Havens and William K. Blodgett, of Point Pleasant, N. J., for a charter to construct an electric railway from Lakewood to Point Pleasant, a distance of nine miles. It is proposed to take over the franchises and rights of way of the Vanderbilt electric railway, which is now in the hands of a receiver.

NEWARK, N. J.—It is reported that the Public Service Corporation has purchased the plant and holdings of the Block Light & Power Company, of which Benedict Pricth is president, and of the Newark Block Lighting Company, of which James M. Seymour is president.

NEWARK, N. J.—At a recent meeting of the Second Ward Improvement Association an estimate of the proposed electric lighting plant for Irvington, prepared by James M. Seymour, of the Block Lighting Company, of Newark, was presented. Mr. Seymour estimates that the cost of a plant with sufficient output to supply 6000 lamps at $34,000, but, owing to the scattered population in the town, does not recommend the installation of the plant at this time.

PRINCETON, N. J.—The University Power Company has offered to deed its extensive system of conduits, built some years ago, to the town. It is understood that the company will turn the system over to the borough free of charge.

SOMERS POINT, N. J.—The City Council has declared in favor of establishing a municipal electric light plant and has adopted a resolution to call a special election to vote on the proposition to issue $15,000 in bonds, the proceeds to be used for the construction of the plant. It is proposed to have the plant in operation the coming season.

TRENTON, N. J.—R. C. Jones and J. Aspinwell Hodge are interested in a project to construct an electric railway from Trenton to Asbury Park.

FORT BAYARD, N. M.—The bill appropriating the sum of $80,000 for the construction of a central power plant and cold storage plant at the United States Army General Hospital, Fort Bayard, N. M., has been passed by Congress.

SANTA FE, N. M.—Arrangements have been completed by the Santa Fé Water & Light Company for the construction of an electric light plant in Santa Fé. Frank Owen is manager.

ALBANY, N. Y.—The Oswego County Light & Power Company has applied to the Public Service Commission, Second District, for permission to increase its capital stock from $1,000,000 to $1,100,000 and to issue $2,500,000 in bonds. The company proposes to develop the water power at Salmon River Falls and construct a power plant and erect transmission lines to supply electricity for lamps, motors and heat in Syracuse, Watertown, Oswego, Rome and Oneida, and probably for interurban railways leading out of Syracuse. It is estimated that 15,000 hp can be developed at a cost of about $3,100,000. The plant complete will cost about $4,000,000.

CASTLETON, N. Y.—The citizens are considering the question of lighting the streets of the village, for which two propositions have been submitted to the Village Trustees, as follows: The Kelly Shoe Company has offered to furnish 60 electric street lamps at $20 each per year; the Corgan Brothers offer to light the streets with acetylene gas for $1,200 per year. The question will be voted upon at the next election.

FREEPORT, N. Y.—At an election held March 16 the citizens voted to appropriate $7,500 for maintaining the street lighting system and to establish an all-night schedule; also to appropriate $15,000 for extensions to the municipal street lighting system and water-works system.

NEWARK, N. Y.—The Newark & Marion Railway Company contemplates extending its railway to Williamson, a distance of six miles. The railway between Newark and Marion, a distance of ten miles, is being operated by steam temporarily.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent school buildings, Department of Education, New York, N. Y., until March 29 for installing electric equipment in new Public School No. 162, on St. Nicholas Avenue, Borough of Brooklyn.

NIAGARA FALLS, N. Y.—It is reported that a syndicate of American and Canadian capitalists is contemplating the construction of an electric railway from Niagara Falls to Toronto, which will include the construction of another bridge about a mile below the falls.

NIAGARA FALLS, N. Y.—The Water Commissioners have decided to accept the offer of the Niagara Falls Hydraulic Power & Manufacturing Company of $20,000 for the pumping station site and water rights, in consideration of which the company will furnish electricity for operating the proposed new pumping station at $9 per hp per year.

NYACK, N. Y.—The Rockland Railroad Company has filed a certificate with the Secretary of State of the proposed extension of its railway from Nyack to Stony Point, Congers to Rockland Lake, West Nyack to Suffern, Nanuet to Pearl River, Sparkhill to State Line, between New York and New Jersey. Benjamin A. Hegeman, Jr., is president, and Arthur C. Miller, vice-president.

PORT BYRON, N. Y.—The citizens on March 18 voted to install an electric lighting system in this village. It is proposed to light the streets with 100 or 150 tungsten lamps of 50 cp; also to erect a substation and to secure electricity for operating the system from the Niagara & Lockport Power Company. The cost of the substation and street lighting system is estimated at $6,000.

ROCKVILLE CENTRE, N. Y.—The citizens on March 16 voted to appropriate $4,500 for extending and improving the municipal electric light plant.

SYRACUSE, N. Y.—The Syracuse Lighting Company has made application to the Public Service Commission for permission to issue $2,500,000 in bonds, of which $207,000 is to be used for extensions to its distributing system and other improvements to its plant, and $2,293,000 to be held for future construction and improvements.

UTICA, N. Y.—The supervisors' committee on lighting the county buildings has decided to engage an electrical engineer to prepare plans and specifications for an electric plant to light the county buildings.

FAYETTEVILLE, N. C.—The Little River Power & Transmission Company is now supplying electricity in Fayetteville for lamps and motors for commercial purposes and also for operating the Fayetteville Street Railway Company's system. The city has entered into a contract for street lighting, which will result in a saving of about $2000 per year. The city was formerly lighted by a municipal electric light plant. The company's plant is located on the Little River, at Manchester, 12 miles above Fayetteville. The power company is erecting a steam plant in Manchester to be used in emergencies.

WADESBORO, N. C.—Surveys are being made with a view of developing the water power property near Wharftown. A. H. Richardson, of Charlotte, N. C., is interested in the project.

DICKINSON, N. D.—Messrs. Hughes & Dieters are planning to enlarge their electric light plant. Two boilers will be installed.

FARGO, N. D.—The City Council is considering the question of entering into a contract with the Otter Tail Power Company to furnish electricity in this city from its plant in Fergus Falls, Minn. The present contract with the local company does not expire until next September.

GOODRICH, N. D.—The Sheridan County Telephone Company has been granted a franchise to construct and operate a telephone system in Sheridan County.

BAINBRIDGE, OHIO.—The Paint Creek Power, Light & Heat Company contemplates the construction of a hydro-electric plant, at a cost of $1,750,000. I. J. Miller, of Fairview Heights, Cincinnati, Ohio, is interested.

CANAL DOVER, OHIO.—The Canal Dover Board of Public Service will award contracts on March 24 for the construction of a municipal electric light plant, for which bonds to the amount of $35,000 have been sold. The plans call for a plant of sufficient output to supply 200 arc lamps and 15,000 incandescent lamps. The new plant will be located near the water-works plant and natural gas will be used as fuel. Electrical service in the city is now supplied by the Tuscarawas County Light & Power Company, of New Philadelphia, Ohio.

CINCINNATI, OHIO.—The capital stock of the Richwood Telephone Company has been increased from $50,000 to $65,000.

COLUMBUS, OHIO.—Bids will be received by the Board of Public Service until March 29 for furnishing material for the municipal electric light plant as follows: Two 150-kw transformers; 76,000 ft. No. 6 B. & S. gage T. B. weatherproof solid copper wire, or an alternative bid for 99,000 ft. No. 4 B. & S. gage bare solid aluminum wire; all as per specifications on file with the Board of Public Service. Edward W. Hirsch is secretary of board.

NORWALK, OHIO.—It is reported that the Sandusky, Norwalk & Mansfield Railway Company is preparing to construct a power plant to operate its system. The company now purchases electricity from the Lake Shore Electric Company.

PIQUA, OHIO.—The Orr Felt & Blanket Company has completed arrangements for the construction of a large mill to be operated entirely by electricity, which will be generated by the company's own plant. Each machine will have an individual motor.

POMEROY, OHIO.—The Pomeroy, Rock Springs & Athens Traction Company is planning to construct an electric railway from Pomeroy to Athens. The power plant will be located on the fair grounds at Rock Springs. A. W. Lee, of Pomeroy, is chief engineer.

BARTLESVILLE, OKLA.—We are informed that John O. Taylor and James E. Hickey, of Bartlesville, and William Moore, of Nowata, Okla., are interested in a project to construct an electric railway between Bartlesville and Nowata, a distance of about 20 miles.

RYAN, OKLA.—An election will be held to vote on the proposition to issue $69,000 in bonds, the proceeds to be used for the construction of an electric light plant, water-works and sewer systems.

TONKAWA, OKLA.—Contracts have been awarded for the construction of a municipal electric light plant and extension of water-works system as follows: For construction work, to Lund & Cunyon, for $15,483; electrical equipment, to the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., for $4,040; engines, to the English Iron Works, for $2,075; for street lamps, to the Collier-Clark Construction Company, for $600; for pump, to the Deane Steam Pump Company, for $1460, and to the Western Valve Company, for hydrants and valves, $626. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are engineers.

WYNNEWOOD, OKLA.—Plans are being prepared for the construction of a municipal electric light plant and water-works system.

ASHLAND, ORE.—Judge Hanna, of the United States Circuit Court, has issued a decree dissolving the temporary injunction against the city of Ashland in the suit of the Ashland Electric Light Company to prevent the city from installing an electric light plant. The City Council has authorized an issue of $77,500 in bonds for construction of the plant.

EUGENE, ORE.—The City Council has granted a franchise to the Lane County Asset Company to construct an electric railway in Oregon, to be operated in connection with the proposed Eugene-Florence electric railway being promoted by the company.

PORTLAND, ORE.—The City Council has authorized City Auditor Barbur to advertise for bids for furnishing electricity for lighting the city on three and five year contracts.

ALTOONA, PA.—The directors of the Edison Electric Illuminating Company have decided to enlarge and remodel its plant and to extend its electrical service. Contracts for equipment, which will include dynamos, electrical apparatus, etc., boilers and engines, will be placed at once. The cost of the work is estimated at $250,000.

ELIZABETH, PA.—The City Council has granted the Peters Creek Street Railway Company a franchise to operate a railway over certain streets in this city which provides for a connection with the Pittsburg Railways Company's lines at Dravosburg.

HAZLETON, PA.—The Harwood Electric Power Company has commenced work on the construction of a large power station at the Harwood Mines, near Hazleton. Four turbines and boilers have been installed and placed in operation. Plans and specifications have been prepared by the Scofield Engineering Company, consulting engineers, Arcade Building, Philadelphia, Pa.

LANSDOWNE, PA.—The date of opening for receiving bids for street lighting has been postponed from March 20 until May. The Borough Council is advertising for bids for lighting the streets of the borough for a term of five years; also for a term of 10 years. Specifications may be secured from William C. Shuster, Jr., 17 Lansdowne Avenue, Lansdowne. John W. Davis is secretary of Borough Council.

PHILADELPHIA, PA.—Chief McLaughlin, of the Electrical Bureau, has submitted a report showing that the cost of installing 520 arc lamps (408 more lamps than now in use) on Market, Walnut, Chestnut and Broad streets, between Vine and Spruce streets, would be $15,940, while the cost of maintenance of the 408 additional lamps would be $40,824 per year.

SCHUYLKILL HAVEN, PA.—The citizens have voted to appropriate $11,000 to make improvements to the municipal electric light plant.

TAMAQUA, PA.—The Edison Electric Illuminating Company has absorbed the plant and holdings of the Tamaqua Light, Heat & Power Company. The last-named company held a contract to light the streets of the city for 10 years. J. G. White & Co., New York, N. Y., are operating managers.

WAYNESBURG, PA.—The Waynesburg & Monongahela Street Railway Company is making arrangements to commence work on construction of its proposed electric railway from Waynesburg to Monongahela, for which contracts have already been placed. W. J. Sheldon, of Waynesburg, is general manager.

WILKES-BARRE, PA.—Bids will be received by A. W. Morse, clerk of School Board, until April 26, for boilers, power plant, heating and ventilating of the High School at Wilkes-Barre as follows: (1) Boilers, breeching and stack. (2) Power plant equipment and heating and ventilating system. (3) Electrical work. Plans and specifications may be obtained after April 5 at the office of Runyon & Carey, engineers, 122 Market Street, Newark, N. J., or at the office of Owen McGlynn, Wilkes-Barre, Pa. A. E. Burnaford is president of School Board.

ANDERSON, S. C.—Plans are being made for alterations and the installation of additional equipment in the Gluck Cotton Mills, of Anderson. The company proposes to furnish electricity for lamps in the mill village, and will also supply electric service to the cottages.

SPARTANBURG, S. C.—The Electric Manufacturing & Power Company has reduced the price of electricity for residential and commercial lighting from 15 to 12 cents per kw-hour, with a discount of from 10 to 60 per cent, according to the amount consumed. A reduction has also been made for motor service. The company has also agreed to extend the street car service to various suburban towns. F. H. Knox is vice-president and general manager.

WELLFORD, S. C.—The Jordan Manufacturing Company has decided to enlarge its plant, which will be operated by electricity. The company manufactures towels and bedspreads.

LEAD, S. D.—The Homestake Mining Company is planning to construct a hydro-electric plant on Spearfish Creek at a cost of about $500,000.

WAGNER, S. D.—The Dakota Gas, Electric Light & Power Company has placed an order with the Minneapolis Steel & Machinery Company for an 80-hp Muenzel producer gas engine and suction gas producer plant. The company already has one Muenzel unit in operation.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company has decided to make extensive improvements to its system in Chattanooga, which will involve an expenditure of approximately $65,000. The work will include a cable from the local exchange to St. Elmo, and from there to Lookout Mountain.

JOHNSON CITY, TENN.—The Austin Springs Railway Company is making arrangements to construct a railway between Johnson City and Austin Springs, a distance of five miles, for which surveys have been made and contracts for rails have been placed. The motive power has not yet been decided upon. J. B. Cox is interested in the project.

RIPLEY, TENN.—The capital stock of the Ripley Light, Water & Ice Company has been increased to $15,000. The company is planning to make improvements to its plant.

WICHITA FALLS, TEX.—The capital stock of the Wichita Falls Water & Light Company has been increased from $75,000 to $100,000.

ST. ALBANS, VT.—The Vermont Power & Manufacturing Company is contemplating the extension of its transmission lines from its plant at Fairfax Falls to Cambridge Junction to furnish electricity for lamps and motors.

COVINGTON, VA.—Application has been made to the City Council by E. M. Nettleton, J. R. Pirkey and William McD. McAllister for a franchise to construct and operate an electric light plant.

RICHMOND, VA.—The committees on light has recommended the City Council to renew the present contract for street lighting with the receivers of the Virginia Passenger & Power Company for one year, beginning July 1, 1909. The contract provides that the company shall maintain, as at present, 854 arc lamps at $54.75 each per year. In addition to the present lamps, the city has the option of ordering 107 additional lamps to be located within the city limits, at the rate of $160 each per year. If less than 100 additional lamps are ordered, the charge will be increased, the rate for 50 additional lamps being $180 per lamp per year. The Virginia Passenger & Power Company has submitted three propositions for additional lamps, with a view of the city purchasing its poles and wires. The first provides that, in addition to the lamps now furnished at $54.75, the company will maintain and operate any number of additional lamps for $40 per lamp per year, provided the city will purchase and erect the additional lamps with transformers, wires, poles and equipment necessary to connect the lamps with the present system, which will remain the property of the city. The second proposition provides that the company will erect, and operate any number of lamps of the type now in use, located anywhere in the city, at $54.75 per lamp per year, provided the city will agree to purchase the entire street lighting equipment in the city at the expiration of the contract, the value to be determined by a board of three arbitrators, the total value not to exceed $50,000. The third proposition provides that the company on the expiration of the existing contract, July 1, 1909, shall sell to the city of Richmond the present street lighting system, including distributing system and transformers, etc., the price to be determined by a board of arbitrators, and to sell electricity to the city to operate the system for one year at the regular rates, to be supplied at one central point over the city's wires.

SEATTLE, WASH.—It is reported that bids are being called in Chicago for equipping the section of the Chicago, Milwaukee & St. Paul Railroad from St. Regis, Mont., to St. Joe, Idaho, to be operated by electricity. It also reported that bids will be received for the construction of 35 miles of track between Gate City and McKenna Junction. The contract for the Tacoma Terminal has been awarded to Twohy Brothers, of Spokane, Wash.

SPOKANE, WASH.—The Okanogan Electric Railway Company, it is stated, has awarded a contract for grading about 40 miles of roadbed. The power plant will be located near Cuess. The company proposes to construct an electric railway from Nighthawk to Brewster, a distance of 60 miles. A. M. Dewey, of Spokane, is president.

SPOKANE, WASH.—Arrangements are being made by the Washington Water Power Company to construct another 60,000-volt transmission line (a tie line) from its substation on Twenty-ninth Street to the new power plant, now under construction on the Spokane River at Little Falls. The company is considering steel tower construction for the new line.

EDGAR, WIS.—It is reported that a stock company will be formed to construct an electric light plant in Edgar.

FORT ATKINSON, WIS.—The plant and holdings of the Cambridge Independent Telephone Company have been purchased by A. W. Larson, of Deerfield, who will improve and extend the system. A direct telephone line will be erected to Deerfield and also another line to Fort Atkinson.

JUNEAU, WIS.—The Milwaukee Western Electric Railway Company has secured a franchise for the section of its proposed electric railway between Hustisford and Beaver Dam. J. W. Barber, of Milwaukee, Wis., is secretary.

MANITOWOC, WIS.—The Wisconsin Knitting Mills Company is building an addition to its plant which will soon be completed. The company will expend $13,000 for new machinery for the new plant, which will be operated by electricity.

MARTINTOWN, WIS.—It is reported that W. E. Bucher, owner of water power rights in Martintown, contemplates raising the dam and constructing an electric power plant and furnishing electricity for lamps and motors in Winslow, Lena, Nora and Warren, Ill.

RICE LAKE, WIS.—It is reported that the Red Cedar Valley Electric Company has purchased the dam site and franchise on the Red Cedar River, and will construct a concrete dam and power house this spring. Four more turbines will be installed.

COCHRANE, ALTA., CAN.—The Calgary Power & Transmission Company, of Calgary, Alta., has entered into an agreement to supply the town of Cochrane with electricity for lamps and motors. The company is also negotiating with several other towns to furnish electrical service.

LETHBRIDGE, ALTA., CAN.—The Alberta government has purchased a site in Lethbridge for a telephone exchange, which will be the long distance headquarters for Southern Alberta. For further information address W. H. Cushing, Calgary, Alta.

MEDICINE HAT, ALTA., CAN.—The Southern Alberta Land Company, it is stated, is making preparations for the construction of an electric railway from Medicine Hat to its holdings.

VICTORIA, B. C., CAN.—The British Columbia Electric Street Railway Company is seeking a franchise to transmit electricity for lamps and motors in Victoria from its $1,500,000 plant to be constructed on Jordan River.

SELKIRK, MAN., CAN.—Sealed tenders will be received by N. Tessier, secretary of the Department of Public Works, Ottawa, until March 31 for the electrical work and fixtures for the new public building in Selkirk.

WINNIPEG, MAN.—Contracts have been awarded by the city for the construction of the transmission line from the Point Du Bois power development to the Williamson Construction Company, of Toronto, Ont., for $118,424, and for the telephone line to R. & D. McLeod, for $23,421.

WINNIPEG, MAN., CAN.—Sealed tenders will be received by Magnus Peterson, secretary of the Civic Board of Control, until April 2 for the supply of materials required for the extensions to the civic electric lighting system during the year. F. E. Cambridge is city electrician.

BRANTFORD, ONT., CAN.—The City Council has passed a by-law authorizing an agreement with the Cataract Power Company to supply the city with electricity for lamps and motors for a term of five years. Under the new contract the company is to furnish 250 arc lamps at $48 per arc lamp per year, which is a reduction of $7 per lamp on the former contract; also agrees to furnish electricity for domestic and commercial lighting at 7.65 cents per kw-hour, instead of 9 and 10 cents as formerly charged.

FORT WILLIAM, ONT., CAN.—The farmers of Paipoonge Township are organizing to secure a rural telephone system, which will be connected with this city and also with Port Arthur. For further information address Dr. D. C. Garver.

LONDON, ONT., CAN.—City Engineer Sifton has recommended to the City Council the acceptance of the offer of the Hydro-Electric Power Commission to supply 5000 electrical hp at $29.81 per hp per year.

ORANGEVILLE, ONT., CAN.—Preparations are being made for the construction of the power plant of the Dufferin Light & Power Company, of Orangeville, the equipment of which will include three 150-kw hydraulic units with step-up transformers to 22,000 volts. It is said that bids for construction of the plant will soon be asked for by Smith, Kerry & Chace, consulting engineers, Confederation Life Building, Toronto, Ont.

OWEN SOUND, ONT., CAN.—A petition is being circulated asking the Government to guarantee $150,000 bonds of the Georgian Bay Power Company, a local concern.

STAMFORD, ONT., CAN.—The Township Council is considering the question of extending the electric street lighting system to Lundy's Lane, Falls View and other side streets in the town. The Ontario Distributing Company has agreed to extend its transmission lines if it can secure contracts to place 800 lamps in residences in that section of the town. A committee has been appointed to make arrangements to secure the service.

TORONTO, ONT., CAN.—Sir Thomas Shaughnessy, president of the Canadian Pacific Railway Company, states that the company will make a number of experiments with electrical storage locomotives on the western lines of the company this year.

TORONTO, ONT., CAN.—Plans and specifications have been completed by K. L. Aitken, engineer in charge of the municipal distributing plant, for copper cables, which have been approved by Alexander Dow, consulting engineer, Detroit, Mich. It is estimated that the cables will cost between $40,000 and $50,000.

MONTREAL, QUE., CAN.—The Bell Telephone Company, of Canada, has appropriated $1,000,000 for improvements and extensions during the year 1909.

MONTREAL, QUE., CAN.—Application is being made for the incorporation of the Canadian, Liverpool & Western Railway Company with powers in addition to the construction of railways, to distribute electrical power. For further information address S. G. McClenahan, Montreal, Que.

BIENFAIT, SASK., CAN.—A local and rural telephone company is being organized here. For further information address Ira F. Brown.

MANOR, SASK., CAN.—Plans are being made to organize a local and rural telephone company in Manor. For further information address W. G. Bell.

OXBOW, SASK., CAN.—The Oxbow Telephone & Lighting Company has decided to build rural lines to Auburnton, Arthur, Boscurvis and Glen Ewen. For further information, address J. P. Tripp.

WASCANA, SASK., CAN.—Steps are being taken to organize a telephone company, which will be known as the Wascana Rural Telephone Company.

Company Elections.

EUREKA, CAL.—At the annual meeting of the Humboldt Gas & Electric Company the present board of directors were re-elected as follows: W. S. Clark, Henry Deering, George Murray and H. Vance.

INDIANAPOLIS, IND.—The stockholders of the Columbus, Greenburg & Richmond Traction Company have elected the following-named officers: August Kuhn, president; R. E. Moore, of Indianapolis, Ind., secretary, and Walter J. Maconaha, of Richmond, Ind., treasurer. The old board of directors was re-elected.

CARTHAGE, MO.—At the annual meeting of the Carthage Water & Power Company the following-named officers were elected: M. B. Daly, president, and Mrs. B. Messenger, secretary and treasurer.

LACONIA, N. H.—At the annual meeting of the Laconia Electric Lighting Company the following officers were elected: W. L. Moran, president; J. T. Moran, vice-president; Thomas E. Steer, treasurer, and Fred L. Thomas, general manager.

WAYNESBURG, PA.—The Waynesburg & Monongahela Street Railway Company, recently incorporated, has organized with the following-named officers: Peter Langsdorf, of McKeesport, Pa., president; W. J. Sheldon, of Waynesburg, vice-president and general manager; J. Carson Sheldon, of Buffalo, N. Y., secretary; Charles Koehler, of McKeesport, treasurer.

New Industrial Companies.

MYERS & MOORE, of Chicago, Ill., has been chartered with a capital stock of $10,000 by A. H. Myers, J. R. Moore and C. C. Ayers. The company proposes to do a general electrical contracting and repairing business.

THE MODERN ELECTRIC APPLIANCE COMPANY, of Mobile, Ala., has filed articles of incorporation with a capital stock of $10,000. The officers are: J. J. Blacksher, president; E. E. Wager, vice-president, and B. B. Chamberlain, secretary and treasurer.

THE CENTAUR MOTOR COMPANY OF ILLINOIS, of Chicago, Ill., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing motors and accessories. The incorporators are: Arthur M. Robbins, Robert E. Haley and Albert E. Lake.

THE L. S. MONTGOMERY COMPANY, of Atlanta, Ga., has been incorporated with a capital stock of $50,000 to deal in electrical supplies and specialties. L. S. Montgomery is president and general manager and Paul de V. Chaudron, secretary and treasurer.

THE NATHAN KLEIN COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 to manufacture electrical and gas fixtures. The incorporators are: Benjamin Besunder, of Passaic, N. J.; Maurice Jacoby and M. Jacoby, both of New York, N. Y.

THE MASHEK ENGINEERING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by G. J. Mashek, H. S. Anderson and G. Frieling, of New York, N. Y. The company proposes to do a dredging, contracting and engineering business.

THE SCHENECTADY LINONITE COMPANY, of Schenectady, N. Y., has filed articles of incorporation with a capital stock of $80,000 to manufacture and handle electric insulation. The incorporators are: M. O. Caldwell, Harvey Leamon and Edwin Clute, of Schenectady, N. Y.

THE MONARCH ENGINEERING COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $25,000 by Harry R. Wait and B. I. Wait, of Buffalo, N. Y., and Thomas H. Hennessy, of Oswego, N. Y. The company proposes to do a general engineering and contracting business.

JAMES H. ROBERTS & COMPANY, of Kittery, Maine, has been incorporated with a capital stock of $150,000 for the purpose of manufacturing and dealing in power transmission materials. The officers are: Horace Mitchell, of Kittery, president; S. J. Morrison, of Portsmouth, N. H., treasurer.

THE COMMERCIAL LAMP COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 to manufacture lamps, machinery and appliances for light and heat. The incorporators are: Henry S. Hooker, Forsyth Wickes and Robinson Leech, of New York, N. Y.

THE GOULD SPECIALTIES CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $60,000 to manufacture machinery, engines and mechanical devices by Robert M. Stephens, of Hackettstown, N. J.; Theron A. Gould, of Newark, N. J., and John B. Wentworth, of New York, N. Y.

THE McCRACKEN BANK PROTECTIVE & FIRE-ALARM COMPANY, of Terre Haute, Ind., has been incorporated, with a capital stock of $100,000. The company will establish and equip a plant to manufacture the McCracken electric alarm system apparatus. James H. McCracken, James M. Armstrong and J. D. Pollom are directors.

New Incorporations.

BIRMINGHAM, ALA.—The Birmingham District Coal, Light & Power Company has been chartered, with a capital stock of $15,000, to furnish electricity for lamps and motors in Birmingham, for which a franchise has already been secured. The officers are: T. H. Aldrich, president, and T. H. Aldrich, Jr., secretary and treasurer.

SAN BERNARDINO, CAL.—The Needles Light & Power Company has been incorporated, with a capital stock of $50,000, by W. B. Palmer, W. W. Perry and M. P. Thye, all of Los Angeles.

BOULDER, COL.—The Eldorado Springs Railway Company has been chartered to construct and maintain a miniature railway at Eldorado Springs. The directors are C. W. Clark, F. M. Hawley, W. W. Seaver, C. A. Miller and H. R. Trowbridge.

DENVER, COL.—The Denver & Fort Collins Interurban Railway Company has been incorporated, with a capital stock of $1,000,000, by Leslie L. De Remer and D. E. Brown, of Denver, Col.

ALEXANDER CITY, GA.—The Big Hillabee Power Company has been incorporated for the purpose of developing the water power of Big Hillabee Creek at Lindsey Shoals, six miles from Alexander City, to be utilized to generate electricity, which will be transmitted to Alexander City for lamps and motors. The officers of the company are: L. W. Robert, president; J. W. Preston, vice-president and general manager; L. W. Robert, Jr., secretary and treasurer; Park A. Dallis, of La Grange, Ga., chief engineer. The main office of the company is at Chandler Building, Atlanta, Ga.

HAMMOND, IND.—The Calumet Traction Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $100,000 and proposes to construct and operate an interurban railway in and through the cities of Hammond, East Chicago and North Calumet and Center townships. The directors are Walter J. Riley, of East Chicago, Ind.; William P. Ijams, of Terre Haute, Ind.; E. L. Keating, Patrick Hanrahan and Edward Bailey.

BLAIRSBURG, IA.—The Cedar View Telephone Company has been incorporated to build a telephone line to Webster City. The officers of the company are: G. W. Coleman, president; H. L. Doty, secretary, and P. C. Stone, treasurer.

BRAINERD, MINN.—The Daggett Brook & Southern Company has been organized to operate a telephone system in Crow County. The officers of the company are as follows: Frank Kienow, president; Frank Wolvert, vice-president, and Leroy Sewell, secretary and treasurer.

KERKHOVEN, MINN.—The Murdock-Kerkhoven Telephone Company has been organized to construct a telephone line from Murdock to Kerkhoven, via Dublin. The officers are: E. T. Dana, president; L. S. Lawson, secretary, and William Pothen, treasurer.

PLATTSMOUTH, NEB.—Articles of incorporation have been filed for the Plattsmouth & Southwestern Interurban Railway Company by Charles C. Parmalee, R. B. Windham, H. D. Travis, J. P. Falter and W. W. Coates. The company is capitalized at $100,000 and proposes to construct an interurban railway between Manley and Murdock.

NIAGARA FALLS, N. Y.—The Cliff Electrical Distributing Company has been incorporated, with a capital stock of $25,000, by Paul A. Schoellkopf and Peter P. Pfahl, of Niagara Falls, and C. P. Hugo Schoellkopf, of Buffalo, N. Y.

HICKSVILLE, OHIO.—The Fort Wayne & Toledo Traction Company has been chartered, with a capital stock of $100,000 to construct an electric railway from Bryan to Fort Wayne, and from Bryan to Montpelier. The incorporators are: R. L. Bastress, C. A. Bastress, W. Behne, R. L. Starr and W. S. Tomlinson.

MT. CORY, OHIO.—The Mt. Cory Farmers' Mutual Telephone Company has been chartered by W. A. Williamson and others.

FLETCHER, OKLA.—The Fletcher Telephone Company has been incorporated, with a capital stock of $10,000, by R. C. Stout, W. E. Nix and J. L. Peden.

KANSAS, OKLA.—The Delaware Central Telephone Company has been chartered by D. A. Smith, W. J. Holbrooks and J. R. Terry.

MANGUM, OKLA.—Articles of incorporation have been filed for the Mangum Light & Power Company, with a capital stock of $100,000, by C. I. Patterson, P. J. Janeway, J. W. Chambers, C. E. Border and T. P. Clay.

MINCO, OKLA.—The Consolidated Telephone Company has been chartered, with a capital stock of $5,000, by G. Dennis, of Mustang; R. L. Bristow and A. C. Bristow, of Minco.

STERRETT, OKLA.—The Sterrett Exchange Telephone Company has been organized by citizens in Sterritt.

WAYNOKA, OKLA.—The Waynoka Electric Light & Power Company has been chartered, with a capital stock of $25,000, by Grant D. Miller and George D. Miller.

WEATHERFORD, OKLA.—The Davis Brothers Telephone Company has been incorporated, with a capital stock of $1,000, by James, Arthur and Myrtle Davis.

ALTOONA, PA.—The Homer's Gap Telephone Company has been organized with the following named officers: John Smith, president; George Moyer, vice-president; Charles R. Foutz, secretary, and B. Mathers, treasurer.

COATESVILLE, PA.—The Christiana & Coatesville Street Railway Company has been organized to construct an electric railway between the two cities named. The company will take over the property and holdings of the Philadelphia, Coatesville & Lancaster Company, which was purchased by a committee of bondholders at a foreclosure sale. It is capitalized at $400,000, of which $137,000 will be used to pay for the purchase, and it is estimated that it will cost about $162,000 to complete the road. When completed it will be leased to the Conestoga Traction Company.

DUQUESNE, PA.—The Duquesne & Dravosburg Street Railway Company has been organized and will apply to the State for a charter on March 29 to construct a street railway in the borough of Dravosburg and township of Mifflin. The company also proposes to construct a railway to Dravorsburg and West Elizabeth. The directors are: A. J. Krill, John C. Cato, T. F. Vankirk and Charles McGinley.

MORRIS, PA.—The Morrisdale Railway Company has been incorporated to construct an electric railway through Clearfield County in the vicinity of Morris. The railway will be about four miles in length. The company is capitalized at $40,000. Charles Steele, of Northumberland, is president.

PHILADELPHIA, PA.—The Terminal Street Railway Company has been incorporated, with a capital stock of $12,000, to construct an electric railway from the end of Market Street Elevated Passenger Railway in Upper Darby through East Lansdowne to Fernwood, a distance of two miles. The incorporators are: John Wolfenden, of Cardington, president; W. I. Shore, Joseph M. Dohen, B. J. O'Connel, of Philadelphia, and Frank B. Rhodes, of Media.

READING, PA.—The Inter-County Electric Company has been formed and will make application to the State for a charter March 29. The company is capitalized at $500,000, and proposes to construct an electric railway from Reading to Allentown, via Lyons and Tipton, 35 miles in length. The directors are: Maxwell H. Bochow, George F. Souwers, Bateman Saddington, Josiah H. Fisher and Frederick R. Perry.

YORK, PA.—The Conewago Rural Telephone Company has been organized to construct a telephone line, which will be connected with the York Telephone & Telegraph Company. The following officers were elected: E. S. Hykes, president; Jacob Bear, vice-president; S. T. Peeling, secretary, and W. H. Gross, treasurer.

WHITEWOOD, S. D.—Articles of incorporation have been filed for the Dakota Western Railway Company by H. E. Cooper, P. W. Benniwell, T. W. Thompson, of Whitewood; Samuel R. Cleaver and Fred A. Robinson, of Empire, S. D. The company proposes to construct an electric railway from Whitewood to Attainment, a distance of 30 miles.

JACKSON, TENN.—The Farmers' Telephone Company has been chartered with a capital stock of $1,000 by William Arnold, J. F. Ward, Edward Hart, Z. T. Johnson and John Steadman. The company proposes to construct and operate telephone lines in Madison and Chester Counties.

JEFFERSON, TEX.—Articles of incorporation have been filed for the Jefferson Ice, Light & Power Company, with a capital stock of $50,000, by John T. MacDonald, M. Bower and R. B. Walker.

ROCKPORT, TEX.—The Rockport & Aransas Pass Railroad Company has been chartered to construct an electric railway from Rockport to the jetties at Aransas Pass, a distance of 11½ miles. The company is capitalized at $11,500 and the incorporators are: C. G. Johnson, Harry Traylor, D. R. Scrivner and W. H. Baldwin.

GUNNISON, UTAH.—The Gunnison Telephone Company has been chartered, with a capital stock of $5,000, and the following officers: T. F. Kearns, president; Leo M. Gledhill, vice-president; Joseph Christensen, secretary and treasurer.

FELCHVILLE, VT.—The Reading Light & Power Company has been incorporated, with a capital stock of $5,000, by Elmer B. Watkins, John E. Dunsmoor, of Felchville; C. O. Randall, of Cavendish, Vt.; C. A. Preston, W. I. Root, O. D. Churchill, S. M. Sherman, P. Root, Sr., and M. S. Amsden, all of Felchville.

ISLE LA MOTTE, VT.—The Isle La Motte Telephone Company has been chartered, with a capital stock of $5,000, to construct telephone lines in Grand Isle, South and North Hero, Isle La Motte and Alburg.

ELLERSON, VA.—The Hanover Telephone Company has been chartered, with a capital stock of $5,000. The officers of the company are E. J. Flippo, of Ellerson, president; J. M. Long, Atlee, Va., vice-president, and J. B. Bradley, of Ellerson, treasurer.

GOODWINS FERRY, VA.—The Spruce Run Mutual Telephone Company has been incorporated with a capital stock of $5,000. L. A. Kessinger is president, and J. D. Scott, secretary and treasurer.

LEXINGTON, VA.—The Rockbridge Power Company has been chartered, with a capital stock of $25,000, to construct and operate a heating, lighting and power plant. W. G. Matthews is president; W. T. Paxton, of Buena Vista, is secretary and treasurer.

LOVINGSTON, VA.—The Central Telephone Company has filed articles of incorporation, with a capital stock of $5,000. The officers are: F. M. Horsey, president; J. C. Clarkson, vice-president, and E. Carter, secretary.

ROANOKE, VA.—The Craig Water Power Company has been organized, with a capital stock of $200,000, for the purpose of developing water power in Meadow Creek and Johns Creek, in Craig County, located about 20 miles from Roanoke. Plans for the project are being prepared by C. S. Wagner, consulting engineer, Brownstown, Pa. A. L. Sibert, of Roanoke, is president of the company.

ROCKY MOUNT, VA.—The Light & Power Company, of Rocky Mount, has been formed and will be incorporated, with N. P. Angle, president; D. H. Dillard, vice-president, and B. L. Fisher, secretary and treasurer.

WAKEFIELD, VA.—The People's Telephone Company, of Wakefield, has been organized, with a capital stock of $4,000 and the following named officers: J. A. Brittle, president; A. W. Holt, vice-president, and N. B. Pond, secretary and treasurer.

GEROME, WASH.—The Southwest Telephone Company has been organized to construct and operate a telephone line from Hunters to the mouth of the Spokane River. D. M. Glasgow is president.

NORTH YAKIMA, WASH.—The Central Washington Investment & Power Company has been incorporated by G. S. Rankin, Alex. McCredy and J. O. Cully, with a capital stock of $100,000, to build an irrigation system and power plant to irrigate 1700 acres of land in the Moxee Valley.

PROSSER, WASH.—Articles of incorporation have been filed for the White Bluffs & Columbia River Telephone Company to construct a telephone line from White Bluffs to Kennewick, which will eventually be extended to Priest Rapids and North Yakima. The company is capitalized at $10,000, and the officers are: F. M. Weil, president; Jay Locke, vice-president, and A. W. Henning, secretary and treasurer.

SEATTLE, WASH.—The Rainier Power & Irrigation Company has been incorporated by Frank Mackean, J. J. Wilson and others. The company is capitalized at $100,000.

SPOKANE, WASH.—The Spokane-Orient Power Company, capitalized at $1,000,000, has been incorporated by C. A. Lunceford, C. H. Patten and A. R. Patten.

FOLLANSBEE, W. VA.—Articles of incorporation have been filed by the Follansbee Light & Water Company, with a capital stock of $25,000, by Thomas J. Mahan, Frank B. Mahan, C. B. Crawford and others.

MADISON, WIS.—The Apple Creek Farmers' Telephone Company, of Freedom, has been incorporated, with a capital stock of $5,000, by Fred A. Zeigler, C. W. Schroeder and H. W. Wieckert.

MILWAUKEE, WIS.—The Midway Telephone Company of Deer Creek, of Taylor County, has been chartered with a capital stock of $10,000, by M. B. Bircks, Almer R. Erickson and D. F. Peterson.

BAGGS, WYO.—The Lower Snake River Telephone Company has been organized by J. W. Cavender for the purpose of operating an independent telephone line in Baggs and other towns in this vicinity.

LUTHER, WYO.—The Golden Prairie Mutual Telephone Company has been organized to operate a telephone system in Luther and adjoining towns. Edward Bergland is manager.

Personal.

MR. J. F. NISBET has been appointed to take charge of the new publicity department of the Triumph Electric Company, of Cincinnati.

MR. L. L. PERRY, for some years electrical engineer with Dr. F. S. Pearson, has resigned his position. Mr. Perry has devoted his time largely to hydro-electric power-house and transmission-line work.

MR. ROBERT THURSTON KENT has resigned as engineering editor of the *Iron Trade Review*, Cleveland, Ohio, to become managing editor of *Industrial Engineering*, Pittsburgh, Pa., a new paper devoted to mechanical engineering subjects. Mr. Kent has been with the *Iron Trade Review* since 1905, and prior to that time was associate enditor of the *Electrical Review*, New York.

MR. WILBUR B. FOSHAY, formerly manager of the Fort Dodge Light & Power Company, of Fort Dodge, Ia., is the successor of Mr. H. Almert in directing the work of the Edison Light & Power Company, United Gas Company and the United Gas & Electrical Appliance Companies, of Wichita, Kan. Mr. Foshay got his early training in five years' work with the U. G. I. Company. Later he was connected for a short time with the Water, Gas, Electric Light & Power Company, of Hutchinson, Kan., which place he left to take up the management of the company at Fort Dodge, where he resigned about the 1st of February. He is already in harness at Wichita and taking over the new work as rapidly as possible.

Trade Publications.

SINGLE-PHASE MOTORS for central station service are convincingly discussed in a pamphlet of the Wagner Electric Manufacturing Company, St. Louis, Mo.

MOTOR-DRIVEN PUMPS of the double-acting piston type are listed and described in Folder No. 4065 of the Fort Wayne Engineering & Manufacturing Company, Fort Wayne, Ind.

DIRECT-CURRENT GENERATORS of the belted type intended for use with internal-combustion engines are described in Bulletin No. 1113 of the Fort Wayne Electric Works, Fort Wayne, Ind.

IGNITION BATTERIES.—The Zoar Battery Company, Zoar, Ohio, has issued a catalogue and price-list dealing with ignition batteries. Storage batteries for isolated plant lighting installations are discussed in a folder issued by the same company.

REFILLABLE ENCLOSED FUSES.—The Crescent Company, 103 West Adams St., Chicago, is sending out a bulletin catalogue illustrating its line of "Trio" refillable enclosed fuses. It is stated that this device will effect a saving of 33 per cent in maintenance expense.

BLOWERS.—The American Blower Company, Detroit, Mich., has issued an illustrated handbook giving interesting information on blowers and exhausters for forges and furnaces. The data are arranged in such a way as to assist the engineer in selecting the proper size and type of fan for his requirements.

FLEXIBLE TUBING for electric wires is described in a booklet issued by the National Metal Molding Company, Fulton Building, Pittsburgh, Pa. This tubing is made of a spiral fiber interwoven with a fine strong thread which binds the spiral into a tube which is run through a rubber solution to cause it to exclude moisture.

COMMUNITY COORDINATION is the title of an interesting pamphlet just issued by the International Lecture Institute, 20 Broad Street, New York City. This new pamphlet of the Institute is written for the

purpose of answering most of the questions asked as to the mission of the Institute, but it is not strictly a publicity circular for general distribution. The pamphlet is divided by the headings into sections, so that a section can be referred to readily in replying to correspondence or to oral inquiries. The extension of the services of the Institute into the industrial field has made such a printed description of its work necessary, though the pamphlet is equally applicable to applied science and the mechanic arts, in connection with which lectures are prepared and delivered also, under the same general plan.

THE VIGO ELECTRIC COMPANY, of Terre Haute, Ind., has filed articles of incorporation with the Secretary of State, with a capital stock of $200,000. The company proposes to generate and distribute electricity for heating, lighting and power purposes. The directors are Frank M. Fauvre, Charles Moniger and Monroe George. The company has a plant nearly completed, situated at the mouth of a coal mine five miles from Terre Haute. It has secured a contract to light West Terre Haute.

THE UNION SWITCH & SIGNAL COMPANY, PITTSBURGH, PA.—At the annual stockholders' meeting, held March 9, the following were elected directors: George Westinghouse, Robert Pitcairn, William McConway, George C. Smith, Thomas Rodd, H. G. Prout and James J. Donnell. It was stated that the company has orders for unfilled business amounting to $1,357,000. New contracts for block signaling and other railroad safety devices are now coming in more freely than at any time during the last 12 months.

Business Notes.

MR. W. D. WOOLLEY has resigned as general manager of the Woolley Electric Company, St. Louis, and while giving up active connection with the company will continue to act as a director.

THE WAGNER ELECTRIC MANUFACTURING COMPANY announces the removal of its district office in Pittsburgh to the Lewis Block, and the appointment of Mr. Ludwig Hommel as district manager.

THE KUHLMAN ELECTRIC COMPANY, Elkhart, Ind., is sending a series of letters to central stations, which in turn will take up the various problems involved in the design, manufacture and use of transformers.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati (Ice Machine Department) has brought out a line of small-belted ammonia compressors for from 2½ to 5 tons refrigerating duty. These machines are especially adapted for electric drive by belt.

THE A. & W. ELECTRIC SIGN COMPANY, of Cleveland, has opened a New York exhibition and salesroom at 1370 Broadway (Thirty-seventh Street), where modern electrical advertising signs and devices, flashers and novelties are on display.

THE MINNEAPOLIS STEEL & MACHINERY COMPANY has received an order from the Dakota Gas, Electric Light & Power Company, Wagner, S. D., for an 80-hp Muenzel producer gas engine and suction gas producer plant. This outfit will be installed in the electric light plant at Wagner, where there is already one Muenzel unit in operation.

THE GREEN MOUNTAIN ELECTRIC COMPANY, Montpelier, Vt., has announced to its patrons that it is the first company in Vermont to employ permanently an illuminating engineer, having secured the services of Mr. W. S. Kilmer, of the Kilmer Company, New York, who will design and install systems of illumination for any service.

THE HABIRSHAW WIRE COMPANY is the subject of an appreciative article in the *Yonkers Daily News* of March 13. Referring to the quantity of product, it is stated that the annual output in wire of all sizes aggregates a length sufficient to girdle the earth several times, and that of one size of wire alone the annual output is no less than 26,000,000 ft., or nearly 5000 miles.

THE NORTHERN EQUIPMENT COMPANY.—The American Boiler Economy Company, of Philadelphia, manufacturers of the Copes boiler feed regulator and the Copes pump governor, has been consolidated with the Northern Equipment Company, Old Colony Building, Chicago, Ill. The branch offices of the American Boiler Economy Company will be continued under the style of the Northern Equipment Company, while the sale of Copes regulators will be handled in Philadelphia by the Adjustable Grate Bar Company.

MR. THOS. P. McCRAY, of Fairmont, W. Va., has been appointed representative, by The Fort Wayne Electric Works, of Fort Wayne, Indiana, for north central section of West Virginia. Mr. McCray is a graduate of Pratt Institute of Brooklyn, N. Y., class of 1899, and during the past ten years has had wide practical experience, having been five years with the New York Telephone Company and four years with other New York City electrical corporations. Mr. McCray's headquarters are in the McCray Building, 323 Madison Street, Fairmont, W. Va.

THE HURLEY MACHINE COMPANY, Chicago, manufacturers of the "Thor Electric" washer and wringer and the "Little Giant" floor scraper, has experienced such an increase of business that its present quarters are not large enough to turn out machines fast enough to meet the demand. It has consequently rented the Hotz & Rehm Building, northeast corner of Clinton & Monroe Streets, which it will occupy after May 1, and will then be in position to take care of the rapidly growing business. In the new place will be a large and beautifully equipped display room, showing washing machine, ironing machine, dryer, etc.; in fact, a complete home power laundry.

THE CROCKER-WHEELER COMPANY has received an order from the Sprague-Warner Company, of Chicago, for 31 small motors, ranging from ½ hp to 20 hp and aggregating about 150 hp. An order for 21 motors, from 1/5 to 10 hp, to drive printing machinery, has been placed by Clark & Courts, Galveston, Texas. The Pittsburgh Steel Company, Monesssen, Pa., has placed an order for two 75-hp, 500-volt motors to drive draw benches. The American Auto Course Company, Chicago, has ordered 15 small motors of ¾ hp each, and the Newton Machine Tool Company has ordered a 22-hp adjustable speed motor with 1:2 speed ratio. An order for nine crane motors has been received from the King Bridge Company, of Cleveland. The Canadian Crocker-Wheeler Company has installed a 60-kva, three-phase, 600-volt, 60-cycle belted machine for the new Canadian factory of L. E. Waterman Company, fountain-pen makers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 16, 1909.

[Conducted by Wm. F. Bissing, Patent Lawyer, 2 Rector St., N. Y.]

915,063. BATTERY PLATE; C. W. Bender, Altoona, Pa. App. filed April 18, 1908. The surfaces of the plates are successively rolled in reverse directions, so as to pack the metal and give an outer stratum of substantially uniform consolidation.

915,075. SIGNALING SYSTEM; N. B. Cregier, Chicago, Ill. App. filed March 16, 1904. Police signaling system to avoid false reporting and compel the patrolman to report only from the box in his own territory. The location of the box is given by an individual signal circuit at the central station, so that when the policeman telephones his name, his beat is checked by the number of the box. A diagram at the central station shows the location of the substation and is provided with a visual signal for each substation on the diagram.

915,077. DESK STAND; W. W. Dean, Chicago, Ill. App. filed Jan. 6, 1904. Portable desk telephone stand and set, with a hollow base and tubular standard. The switch hook has an arm extending through the standard which controls contacts in the hollow base.

915,079. TELEPHONE RECEIVER; James Dixon, Cleveland, Ohio. App. filed Nov. 23, 1908. For partly deaf persons. Is provided with an additional lug which is vibrated by the diaphragm and which can be pressed against the bony structure adjacent to the outer ear.

915,081. RAILWAY TRAFFIC CONTROLLING APPARATUS; F. L. Dodgson and W. K. Howe, Rochester, N. Y. App. filed Aug. 28, 1908. Route locking system for interlocked switches, whereby when the train has entered a certain route, the route may be locked and any switch of the route automatically unlocked immediately after the train has passed off the track section containing the switch, thus saving time and attention of the tower man. A battery has one pole connected to one conductor and its other pole connected to a second conductor by two feed wires which supply current to translating devices which control the switches.

915,112. ELECTRIC AND PNEUMATIC GOVERNOR; W. K. Rankin, Philadelphia, Pa. App. filed May 22, 1907. For an electric air compressor which is actuated when the pressure reaches a maximum. Means are provided whereby different degrees of extreme pressure may be had by change of attachments.

915,135. INCANDESCENT ELECTRIC LAMP SOCKET; A. Weber, Sr., Schenectady, N. Y. App. filed Oct. 1, 1906. Provides an insulating plate between the end flange on the shell and the contact plate and an insulating lining for the shell.

915,152. TROLLEY POLE; G. T. Barr, Sr., Memphis, Tenn. App. filed Aug. 3, 1908. A trolley pole that can be replaced by the motorman at the front of the car by means of a cord attached to the pole, passing around a drum to which a handle is secured, which handle is located near the motorman.

915,154. TELAUTOGRAPH; E. Belin, Paris, France. App. filed Jan. 17, 1908. For reproducing at a distance an original photograph by means of another photograph which is a copy of the first. The transmitter carries a surface slightly in relief, the variations in the relief being translated into variations of electric intensity which are then transformed to a distance and retransformed into variations of light intensity which are subsequently recorded.

915,172. MANUFACTURE OF ALLOYS OF SILICON; Hans Goldschmidt, Essen-on-the-Ruhr, Germany. App. filed April 24, 1908. For producing a calcium silicon alloy with barium or strontium free from carbon which consists in heating silicon or ferro-silicon with an excess of an oxid of the alkaline metal in an electric furnace in presence of a flux producing a crumbling slag.

915,188. SAFETY APPLIANCE FOR RAILWAYS; C. J. Kintner, New York, N. Y. App. filed Aug. 14, 1903. For single-track roads in which the engineer is warned and the car automatically stopped should he fail to observe the danger signal set by the preceding car. The signal-controlling means has two circuits, one permanently closed to a low-voltage source and the other, including the same source and connected at its opposite ends to parallel service rails, in combination with circuit-closing means carried by the car.

915,189. SAFETY SYSTEM FOR ELECTRIC RAILWAYS; C. J. Kintner, New York, N. Y. App. filed Jan. 26, 1903. Particularly for the third-rail type to prevent front or rear collisions, in which

any particular part of the third-rail is temporarily disconnected, when necessary, without delaying traffic. A switching device is carried by each car which automatically disconnects the motor, and semaphores are located at intervals along the track which automatically actuate the switching devices.

915,190. RAILWAY SIGNAL; C. J. Kintner, New York, N. Y. App. filed July 20, 1903. Improvements in electrically controlled railway signals in which the control thereof is effected by currents of low potential and the rails are utilized for the control. The home and distant signals in a block are controlled by the movement of the car without relays or other circuits.

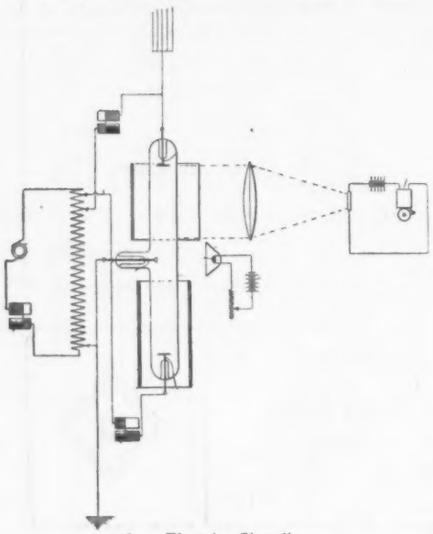
915,193. TROLLEY CATCHER; G. W. Kramer and A. G. Hague, Des Moines, Iowa. App. filed July 31, 1903. An attachment for the trolley pole to catch the trolley when the pole leaves the wire. Makes use of guard wings attached to the carrier in which the wheel is mounted, which wings project from the sides of the carrier.

915,237. ELECTRIC SIGNALING SYSTEM; H. W. Souder, Conshohocken, Pa. App. filed June 10, 1907. Improvement on 795,314 in which a signal circuit extends along the block, a circuit controller is provided at each end including an electromagnet resetting device and a resetting circuit extends along the block which is controlled by a car leaving the block.

915,238. ELECTRIC ROAD-CROSSING SIGNAL; H. W. Souder. App. filed June 29, 1907. For ringing a bell at the crossing, which is automatically operated by the current in a normally open circuit supplied with current by a normally open generator circuit, the generator circuit being closed by a passing car, which action thereupon closes the bell circuit.

915,246. AUTOMATIC ACCELERATING CONTROLLER; H. F. Stratton, Cleveland, Ohio. App. filed July 7, 1908. For use on electric cars to keep the acceleration at a certain rate which cannot be exceeded even when the operator throws the master controller rapidly to the full-on position. Provides an acceleration relay directly responsive to the acceleration of the load which gives a slower than normal acceleration on up grades and faster on down grades.

915,249. APPARATUS FOR WELDING IN ELECTRICITY; E. C. Thompson. App. filed June 11, 1907. To secure more uniform heating by the current. The article is held by means of clamping dies which substantially encompass one of the parts to be joined, and blocks are provided for carrying the dies which have equally direct electrical connection with the electrode.



915,280.—Electric Signaling.

915,415.—Manufacture of Metallic Mirrors.

915,257. ELECTRICAL MEASURING INSTRUMENT; C. Wiler, Chicago, Ill. App. filed Sept. 10, 1906. For alternating or direct currents in which a stationary flat solenoid is used combined with a soft-iron armature with axes of unequal length which dips in the coil, normally presenting its long axis to the coil and when drawn therewithin presenting its shorter axis. This reduces hysteresis.

915,280. ELECTRIC SIGNALING; Reginald A. Fessenden, Washington, D. C. App. filed Feb. 8, 1907. Vacuum tube receiver for wireless telegraphy having an exhausted tube containing gas of the helium group, with several paths of discharge together with connected differential governing circuits which are unbalanced by the received impulses so as to shift the path of discharge and produce a signal.

915,290. CONTROL SYSTEM FOR ELECTRIC HOISTS; J. H. Hall and J. F. Schnabel, New York, N. Y. App. filed Aug. 10, 1908. The speed of lowering is under the control of the operator and the brake is a magnetic brake having its releasing winding in series with the motor. A controller connects the field windings of the motor and the winding of the brake in a circuit having a resistance, and the armature of the motor is connected in another circuit containing a resistance. This makes a self-protective system.

915,311. ELECTRIC VEHICLE AND CABLE REEL; F. L. Sessions, Columbus, Ohio. App. filed March 24, 1903. For coal-mine locomotives in which the electric locomotive is kept electrically connected with a distant fixed conductor by means of a cable controlled by a reel and brake.

915,328. STORAGE BATTERY JAR; C. W. Bentley, Binghamton, N. Y. App. filed June 19, 1908. Prevents short-circuiting and provides a cover for hermetically sealing the jar.

915,330. INSULATOR AND WIRE CLAMP; J. Blackburn, St. Louis, Mo. App. filed March 2, 1908. Particularly for cross-arms and adapted to hold a wire without the use of tie wires. The body is of insulating material, in the upper portion of which is formed a V-shaped notch which follows a compound curve across the insulator.

915,334. HARMONIC RINGER; M. S. Connor, Rochester, N. Y. App. filed Aug. 13, 1906. Selective apparatus for telephone systems, in which the ringer is tuned to respond to an alternating current of definite frequency, the magnet operating the ringer being polarized.

915,339. VENTED STOPPER AND STORAGE BATTERY JARS; B. Ford, Philadelphia, Pa. App. filed June 4, 1907. For filling the jar comprising a tubular casing open at each end and having at one end means for connecting it with the jar, together with a detachable stopper cone which closes the other end of the casing and is provided with a hollow cone suitably perforated.

915,348. OVERFLOW ALARM; J. A. A. Heydegger, Newark, N. J. App. filed Oct. 31, 1908. For use with drip pans of refrigerators, which rings a bell and is controlled by a float when the pan is full.

915,375. INSULATING THIRD-RAIL SUPPORT; D. M. Pfautz and J. L. Luckenbach, Philadelphia, Pa. App. filed June 29, 1908. A plurality of independent supporting means carrying the third-rail so that if one breaks the rail will still be supported. The rail is also provided with a hood.

915,381. OUTLET BOX; G. Pullets, New York, N. Y. App. filed April 24, 1907. The space between the box and the surface of the wall is filled in so as to prevent sparks from reaching the woodwork, by means of an adjustable, spirally coiled device formed from flexible strips of spring metal.

915,406. INSULATOR; S. and W. O. Bartley, Calhoun, Ill. App. filed June 17, 1908. A sectional insulator is provided with means for preventing the entrance of rain, etc., and is effectively ventilated. Insulating material is arranged within the sections of the casing, and wire-receiving recesses and cavities are arranged for the circulation of air, together with shields upon the ends of the upper casings which overhang the adjacent portions of the wire.

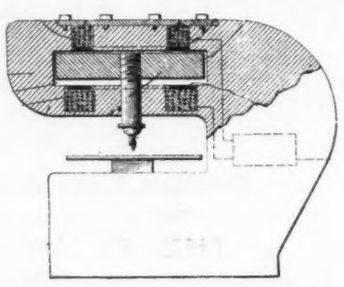
915,415. MANUFACTURE OF METALLIC MIRRORS; S. O. Cowper-Coles, Westminster, London, Eng. App. filed Nov. 8, 1907. Mirrors for searchlights are produced by electrolytically depositing upon the back thereof copper and then depositing upon the surface a yellow reflecting metal which is then ground or polished.

915,438. ELECTROMAGNETIC APPARATUS FOR RECIPROCATING MACHINE TOOLS AND THE LIKE; H. A. Hornor, Riverton, N. J. App. filed Aug. 17, 1907. For reciprocating machine tools, by providing an armature and electromagnets with an automatic switching apparatus whereby the magnets are intermittently energized without attention from the operator.

915,488. FURNACE FOR THE TREATMENT OF METALS; W. Schemann and J. Brown, Bombach, Germany. App. filed Oct. 19, 1907. A furnace in which the ferromanganese is melted separately, thus saving manganese. Three grooves are formed in the hearth of the furnace for the reception of the metal, a cross-conduit connects the grooves at one end, and an electrode enters the other end of each groove, the metal being supplied to the grooves.

915,518. TELEPHONE APPARATUS; F. S. Weyrs, Philadelphia, Pa. App. filed Oct. 8, 1906. Provides a holder for the telephone, thus doing away with the necessity of the user holding it. A base frame which can be clamped to the base of the telephone apparatus is provided with a pivoted rod and pivotal arms to carry the receiver.

915,526. ELECTRIC ARC STEAM GENERATOR; W. W. Wonner, Rossville, Pa. App. filed May 26, 1908. The boiler is provided with a plurality of tubes, in each of which an electrode of an arc light is inserted. The heat of the arc pasing through the tubes enters the water of the boiler and generates steam.



915,438—Electromagnetic Apparatus for Reciprocating Machine Tools and the Like.

915,592. TELEPHONIC EXCHANGE SWITCHBOARD; E. A. Graham, Brockley, London, Eng. App. filed June 21, 1907. Telephone switchboards for use in the navy and adapted to resist the weather, comprising a casing having a central chamber adapted to receive a number of separately removable instrument sections, an upper chamber containing a number of electrical terminals, a lower chamber receiving a number of contacts for the instrument, cords, together with a front door for the central chamber and removable doors for the upper and lower chambers.

915,625. TELEPHONE RECEIVER; A. Rector, New York, N. Y. App. filed March 13, 1908. Secures pleasanter and softer tones from the receiver by providing a hollow tubular extension, which can be fastened to the receiver over the diaphragm and has a central sound aperture corresponding with the bore of the earpiece.

915,657. ELECTRIC GLOW LAMPS; Werber V. Bolton, Berlin, Germany. App. filed May 31, 1902. An incandescent body consisting of a homogeneous body of commingled metallic tantalum and tantalum carbid.

915,668. WATER-COOLED ELECTROCARBON CONNECTION FOR ELECTRIC FURNACES; C. A. Duncan, Duluth, Minn. App. filed Oce. 5, 1908. A water-circulating means is arranged between the metal and carbon parts of the electrode so as to keep it cool.

915,700. TROLLEY SWITCH; J. J. Ruddick, Newton, Mass. App. filed May 28, 1906. A switch operated by the trolley wheel to actuate signals. A trip is provided having an inertia member (a weight), yieldly by-connected to the trip, and movable contact member connected to and operated by the inertia member.

915,719. ELECTRIC CONTROLLER; W. P. Cosper, Boston, Mass. App. filed June 27, 1909. For controlling the currents supplied to motors so as to prevent an operator turning on the current faster than the motor can carry it. A gravity-acting timing element checks the movement of the controller lever.

915,720. CONTROLLER REGULATOR; W. P. Cosper and J. O. Johnson, Boston, Mass. App. filed Dec. 21, 1907. A regulator which enables the current to be instantly turned off and which controls the supply of current by means of a tortuous passage in which means are provided to retard the turning on of propelling current but which permits instantly cutting off the current.